"Shifting the Pollution Problem: Recycling Plastics in Southern China"

By

Kathryn Palko

A thesis submitted in partial fulfilment of the requirements for the
Master of Arts in
International Development Studies
at
Saint Mary's University
Halifax, Nova Scotia
November 18, 2005

Approved By:

Dr. Anne Marie Dalton
Supervisor

Dr. John Devlin
1st Reader

Dr. Julia Sagebien
External Examiner

Your file Votre référence
ISBN: 0-494-15259-1
Our file Notre référence
ISBN: 0-494-15259-1

Abstract

"Shifting the Pollution Problem: Recycling Plastics in Southern China"

By Kathryn Palko

The thesis examines the effectiveness of recycling as a market remedy for the environmental impacts of wastes. A case study of the market for recycled plastic wastes is presented. Data was collected on the North American plastic waste market, and on environmental and labour conditions in nine plastics recycling factories in Guangdong, China, which import plastic wastes from developed nations for processing. Land and air pollution, as well as excessive work hours and occupational health concerns were identified. Findings show that the integration of plastics recycling into a global market has shifted the impacts of plastic waste management from North America to less powerful citizens in China. Additionally, the case study revealed the difficulty of tracing plastic waste as a commodity and thus, in determining accountability within a complex, global trading network. These findings strongly indicate that policies which rely on the market to provide environmental protection, are inadequate. Alternative policy instruments are suggested, which would shift environmental decision-making from the private to public sector.

November 18, 2005

Acknowledgments

A number of people provided me with guidance and support during the course of this study.

First, I would like to offer special thanks to RRFB Nova Scotia, specifically Roy Sherwood, for providing the financial support necessary to conduct field work for the project. I would also like to thank Barry Friesen, former Solid Waste-Resource Manager at the Nova Scotia Department of Environment and Labour for the idea and impetus for the study and for all of his support and encouragement.

In China, a number of people were kind enough to assist me, not only as translators but as invaluable research assistants. I would like to offer special thanks to Mr. Shawn Shen, former classmate, and Graduate of the International Development Studies Masters Program, for his research support and for helping me overcome some of the cultural challenges I was faced with.

Finally, I would like to thank my committee, especially Professor Anne Marie Dalton and Professor John Devlin, for their advice, insight and encouragement.

Table of Contents

List of Figures

Introduction

This thesis grew from a convergence of two interests - my academic interest in issues of environment and development, and my work experience in the field of solid waste management.

The objective of the thesis is to contribute to the debate concerning the causes and remedies of environmental degradation in relation to our global production-consumption system. A case study approach is used to demonstrate the inadequacy of relying on the market to remedy environmental problems. The case examines recycling as a market remedy to the impacts created by plastic wastes.

The impact of the industrialized world's high consumption levels on the global environment is of growing concern. While many citizens in the developing world lack even the most basic resources required for subsistence living, the industrialized world is often criticized for consuming a disproportionate share of the world's energy and material resources, and generating high levels of waste. Not only are northern levels of consumption seen as inequitable, but they are considered to be the driving force behind global environmental degradation.

Global market forces critically influence environmental degradation, since production and consumption decisions determined by the market do not take into account non-economic concerns. Neoclassical economists argue that market forces are not adequately dealing with environmental problems, because market prices for environmental goods and services do not reflect total social costs and benefits. Environmentalist critics argue that the failure of the market is due to more fundamental

characteristics of the system itself, concerning the economic criteria of environmental decision-making and power inequalities.

These two perspectives have important implications for the development of remedies to environmental problems. Therefore, it is crucial that their arguments be closely examined and support for each be assessed.

I have chosen to focus on the environmental problem of waste, a form of pollution that has become incorporated into global trade networks. To manage waste, communities in developed countries have been adopting aggressive recycling programs. Recycling appears to be an effective way to address impacts since it diverts waste from the environment, while also reducing resource and energy requirements for new products. The strategy also allows producers to continue with 'business-as-usual,' while citizens can continue to enjoy the convenience of a consumer lifestyle, relieved of worries that they are contributing to an environmental problem.

Plastic bottles and bags are examples of post-consumer waste which have become common items in recycling programs. A product of the petrochemical industry, plastic has long been in the public eye for causing environmental problems. The production of certain plastics (polyvinyl chloride) has harmed worker health, while plastic waste creates concerns for its persistence in the environment. It does not degrade naturally, can produce dangerous dioxins when incinerated, and can find its way into oceans, damaging marine ecosystems. Recycling has offered fresh promise that a remedy has been found for reducing these impacts.

However, even recycling is integrated into the global market system. As I discovered working in the Solid Waste-Resource branch of the Nova Scotia Department

of Environment and Labour, decisions determining the fate of the material from North America's recycling programs are based on economic, rather than environmental goals. As a result, some of the plastic bottles and bags that environmentally conscious consumers place diligently into their blue bags or boxes, are sent to other nations for recycling - often in Asia. The export of these materials is the result of decisions made by a variety of economic actors in an intricate global trading network in plastic waste.

Prior to conducting my field study, I spoke with two researchers who had observed Asian recycling facilities first-hand. In 1992, researcher Ann Leonard investigated 15 recycling plants in Asia, which received plastic waste from industrialized nations, including Canada. Leonard (1992) saw unprotected workers melting down plastics, and discovered that much of the imported plastic was unusable, with up to 40% landfilled or simply dumped in the surrounding area. In December 2001, while investigating electronics recycling operations in China, another researcher observed plastics recycling facilities with conditions similar to those described by Leonard (J. Puckett, personal communication, July 6, 2004). His observations were not documented.

These researchers' accounts compelled me to speculate - in terms of reducing the environmental and social impacts of consumption, did it make sense for the developed world to ship its plastic packaging all the way to China? In a world concerned with global sustainability, and relying on recycling as a major avenue towards achieving this goal, did the market know best?

The specific question that this thesis seeks to answer is – can the environmental impacts resulting from plastic wastes be remedied through a global market in these materials?

Chapter 1 is an examination of theoretical perspectives of environmental problems, explained in relation to our economic system. Neoclassical theorists suggest that the market should decide the appropriate level of environmental protection, and that price distortions are to blame for current environmental problems. Their critics argue that environmental problems are better explained in terms of the market's sole reliance on economic criteria. They also offer an explanation for the distribution of environmental impacts, explaining them in terms of the shifting of impacts from more powerful to less powerful economic agents. Finally, they use empirical evidence to demonstrate how international trade can act as a mechanism to shift environmental impacts from rich to poor nations.

In Chapter 2, the environmentalist perspective is applied to the problem of waste and the remedy of recycling. This chapter shows how the absorption of recycling into the global marketplace subjects it to the same economic forces that shift impacts, reducing environmental impacts in developed countries but creating environmental and health problems in developing nations. This more focused literature reveals the danger in allowing the economic criteria of the market to manage environmental problems.

The methodology for my case study is outlined in Chapter 3. This chapter describes methods of data collection used to conduct my field research in Canada, Hong Kong, and the province of Guangdong, China. Both primary and secondary data were collected in this research to illustrate the broader issues of Chapters 1 and 2. These issues concern economic efficiency, power and inequality, and the distancing of impacts. Data collected concerned environmental and labour conditions, including land and air pollution, and wages and working hours in plastics recycling factories

The case study of the plastic recycling market in Chapter 4 adds to the literature review by illustrating the theoretical concepts already discussed, and showing how they are operationalized in the world economy. This case explores the complexity of a single commodity chain (plastic waste), showing how the separation of production and consumption activities exacerbates environmental problems by re-distributing impacts to those unable to resist them; and by distancing and obscuring impacts; in other words, making them 'invisible' to the beneficiaries of that economic activity, and to the regulators of that activity.

In Chapter 5, I discuss the implications of my findings on the plastic waste trade, within the broader context of the dominance of production and consumption decisions by economic criteria. I will conclude my paper by suggesting alternative strategies to address environmental problems and the shifting of impacts.

Chapter 1: The Environmental Problem of our Production-Consumption System

"... All available evidence shows that the environmental crisis has been precipitated almost exclusively by the North's wasteful and excessive consumption" (Banuri, 1993, p. 50).

Economic Development and the Environmental Problem

Concerns over a nation's development are generally confined to the poor regions of the world. However, as Becker and Jahn (1998) put it: "The far more difficult and more dangerous development problem is probably not located in the poor south but in the rich capitalist industrialized countries of the North" (p. 74). Excessive consumption by wealthy citizens is depleting natural resources, materials and energy, beyond the earth's capacity to replenish them, while producing wastes and pollutants beyond the earth's capacity to absorb them.

Several respected international institutions have released disquieting reports about the ecological impacts of human consumption. The Millennium Ecosystem Assessment (2005), launched by U.N. Secretary-General Kofi Annan in June 2001 and completed in 2005, reveals that approximately 60 percent (15 out of 24) of the ecosystem services that support life are being degraded or used unsustainably. These services include fresh water, capture fisheries, air and water regulation, and the regulation of regional climate, hazards and pests. The report further warns that "there is established but incomplete

evidence that changes being made in ecosytems are increasing the likelihood of nonlinear changes in ecosystems (including accelerating, abrupt and potentially irreversible changes) that have important consequences for human well-being" (Millennium Ecosystem Assessment, 2005, p. 1). The study was conducted by over 1300 experts from 95 countries.

The World Wildlife Fund's 2004 Living Planet Report presents similar concerns over consumption levels, warning that humanity's ecological footprint has grown to exceed the earth's biological carrying capacity by 20%. A population's ecological footprint is the total area of productive land or sea required to produce all the crops, meat, seafood, wood and fibre it consumes, to sustain its energy consumption and to give space for its infrastructure (World Wildlife Fund, 2004). In other words, human beings are consuming the annual equivalent in biologically productive capacity of 1.2 earths, a trend that will lead to ecological collapse, if left unchanged. Whether or not such estimates are accurate in quantitative terms, the concept of ecological footprint serves as another unsettling indicator of the environmental effects of rising consumption levels.

The ecological impacts of consumption arise disproportionately from the affluent nations of the world. According to the Worldwatch Institute's State of the World Report on the consumer society, the 12 percent of the population living in North America and Western Europe account for 60 percent of global consumption, while the one third living in South Asia and sub-Saharan Africa account for only 3.2 percent (Gardner, Assadourian & Sarin, 2004, p. 5).

Excessive consumption by the rich world not only contributes disproportionately to the world's environmental degradation but also deprives developing nations of

resources needed for their own future development. Furthermore, in some situations, the environmental impacts of the rich world's consumption are felt directly by the citizens of developing nations. This aspect of consumption will be discussed in more detail throughout the remainder of this paper.

Explaining Environmental Problems

As already indicated, the environmental problems which result from present consumption patterns are not only unsustainable in their magnitude, but unjust in their global distribution. Several theorists have attempted to explain these environmental impacts in relation to our present market economy. These explanations will be elaborated on below, from the perspectives of neoclassical economists (including environmental economists), and environmentalists.

In the neoclassical tradition, economists explain environmental degradation in terms of market failures, which affect "efficiency". According to neoclassical economic theory, the goal of society is one of maximizing the sum of benefits – what people are willing to pay for something - minus the sum of costs (Pearce & Turner, 1990). This balancing of benefits and costs is captured in the economic definition of efficiency. Economic efficiency occurs at the point where the marginal benefits of an activity equal the marginal costs (Field & Olewiler, 2002, p. 429). Marginal benefits refer to additional welfare improvements that correspond to an increase in economic activity. Marginal costs refer to additional welfare damages - such as those resulting from pollution.

On the level of the firm, economic efficiency translates into maximizing a given output of production at the lowest possible cost. All firms pursue this goal of economic

efficiency, in striving to maximize their benefits (i.e. profits). The problem, according to economists, is that firms do not tend to account for costs borne by other members of society, as they strive for efficiency - they only account for their own private costs and benefits. Economists define unaccounted costs as 'externalities'. By definition, these costs (also referred to as "third-party' costs or "spillover' effects) are welfare losses suffered by people who are not directly involved in the economic transactions between buyers (consumers) and sellers (producers). Examples of these costs include damages people suffer due to the worsening of environmental quality, such as health effects from pollution and loss of environmental services (water quality), in addition to less tangible benefits based on aesthetic and other non-economic values (Downing, 1984). Two conditions are deemed necessary for an external cost to exist – that an activity by one agent causes a loss of welfare to another agent; and that the loss of welfare is uncompensated (Pearce and Turner, 1990, p. 61). A common example of an environmental externality is the uncompensated welfare loss to fishermen from an upstream factory releasing effluent into a river. The factory does not pay for waste disposal, nor do the beneficiaries of the factory's products; however there are costs to other members of society – namely the fishermen who lose access to the fish killed by the pollution.

External costs create a situation of social 'inefficiency,' in economic terms. As such, they at the heart of the environmental problem as far as economists are concerned.

Other economists have slightly different views of the environmental problem. Economists such as Charles Lindblom, Herman Daly, William Kapp, and Arthur Pigou

agree that externalities are a problem; however they go further in emphasizing the danger of the free market in encouraging the shifting of costs.

Lindblom (2001) observes that the very motivations that make capitalist market systems efficient, are the same motivations that often plunge it into inefficiencies. "The economic logic of weighing costs and benefits exclusively for self-interest blows an enormous hole in arguments for market system efficiency," (p. 149) he notes. The achievement of market efficiency would evidently require that a*ll* costs and benefits are included, which contradicts the strategy of efficiency on an individual level. (As already noted, the individual pursuit of economic efficiency is based on private gain, which results in 'externalities' or inefficiencies.)

Along these same lines, William Kapp (1971) explains externalities not as 'market failures' but as 'cost shifting successes' at the business level. Herman Daly (1996) notes that "profit-maximizing firms in competition always have an incentive to externalize their costs to the degree they can get away with it" (p. 232). Critic Paul Wachtel (1998) agrees that "externalizing and socializing costs while privatizing and internalizing gains is virtually the explicit mandate of the corporate CEO." (p. 260).

Furthermore, (ironically) the economic criteria of efficiency actually *discourages* firms from behaving in a socially efficient manner. "Even when businesses are aware of the social costs of their activities," Lindblom (2001) notes, "their market incentives tell them to go ahead anyway" (p. 164).

These critics point out that the process of cost externalization in business is an outcome of the economic criteria upon which the decisions of our market system are based. Kapp (1971) blames cost shifting on "the assumption that entrepreneurial outlay

is an adequate and significant measure of the true total costs of production", and that market prices and private returns are "significant and relevant standards for the measures of the benefits of production" (p. 238).

In other words, "it is not personal desires for pollution, but rather impersonal market forces and opportunities that create threats to health and nature" (Ackerman & Heinzerling, 2004, p. 17).

Remedies to Environmental Problems

The Economic Perspective

Economists who explain environmental problems in terms of 'externalities' attribute them to an absence of markets for environmental goods and services. They consider the environment to be an unpriced commodity in our economic system. Consistent with this view, they believe that the market simply needs to be 'corrected' by putting a price on environmental goods and services. Once the price is right, the market will then be able to determine the appropriate level of environmental protection.

Environmental economists have developed two main valuation methods of putting prices on traditionally unpriced goods. Both determine prices according to how much people are 'willing to pay' for them. The first is 'hedonic pricing', where preferences are revealed by real-life demand for associated products, for example determining how much people value a landscape by looking at real-estate prices in that area (Jacobs, 1997, p. 71). The second method is 'contingent valuation', where a hypothetical market is created and people are asked how much they would be willing to pay for an

environmental good or service (ie. a forest, clean water, etc) or how much they would need to be paid to lose it.

Economists have used these techniques to assign a monetary value to everything from blue whales to human lives. According to one economist, the only real difference between non-monetary costs and "intangible" or "noneconomic" costs lies in the difficulty of measuring them (Ruff, 1970, p. 25). Furthermore, he suggests that, simply because something is difficult to measure does not imply that it does not have a price.

> Those who call for immediate action and damn the cost, merely because the spiny starfish and furry crab populations are shrinking, are putting an infinite marginal value on these creatures. This strikes a disinterested observer as an overestimate (Ruff, 1970, p. 25).

In other words, some economists reject the notion that there are things which are priceless.

In an effort to remedy the problem of uncounted costs, economists have attempted to broaden their analysis of costs and benefits to environmental goods and services (which are assigned monetary values), and have adopted the goal of "social efficiency." The socially efficient level of production for a firm, or group of firms is determined by incorporating all social costs and benefits (Field & Olewiler, 2002, p. 440). The level of physical pollution which corresponds to this socially efficient level of production is labelled the "optimal level of pollution" (Pearce & Turner, 1990). Below and above this level of production are considered socially inefficient in terms of 'not enough' or 'too much' pollution. At higher levels of production, the additional impacts on welfare ("marginal costs") that come with further increases in production are considered to outweigh the additional socio-economic benefits ("marginal benefits"). Conversely,

below the 'optimal' level of production, economic analysis determines that the benefits from a further increase in pollution would outweigh the additional welfare damages.

Economists also determine optimal pollution to be at the level of production where the marginal abatement costs (the additional cost of reducing pollution by one unit) is equal to the marginal damage cost (the additional loss of welfare resulting from the extra unit of pollution) (Field & Olewiler, 2002, p. 432). The economic logic for "too much' environmental protection" is explained in terms of opportunity costs.

> The prevention of environmental damage is costly. Work must be employed to operate pollution control equipment. Capital must be invested in the equipment. Land must be used to locate equipment or to hold wastes for future release. All of these factors of production could be used to produce other goods and services instead. The cost of pollution control is the opportunity cost of resources (land, labor and capital) used; that is, the amount of shoes, bicycles or other goods that could be produced with these resources (Downing, 1984, p. 27).

In the view of these economists, the value of putting resources towards environmental protection is no different that investing those same resources in any other goods and services in the economy.

An extreme example of the economic logic of 'optimal' pollution is reflected in an infamous 'leaked' memo from former World Bank chief economist Lawrence Summers to his staff in 1991. In this memo, he argued that on an economic basis, there should be more migration of environmentally hazardous industry and waste to less-developed countries. His logic was as follows:

> The costs of pollution are likely to be non –linear as the initial increments of pollution probably have very low costs. I've always thought that under-populated countries in Africa are vastly UNDER-polluted, their air quality is probably vastly inefficiently low compared to Los Angeles or Mexico City. On the lamentable facts that so much pollution is generated by non-tradable

> industries (transport, electrical generation) and that the unit transport costs of solid waste are so high prevent world welfare enhancing trade in air pollution and waste (as cited in Tabb, 2002, p 48).

This logic also demonstrates the failure of cost-benefit analysis to address distributional concerns.

The Environmentalist Perspective

In contrast to economists, environmentalists consider the use of economic criteria such as 'optimality' and 'social efficiency' as inappropriate for environmental decision-making. For one thing, the notion that pollution is acceptable so long as it is 'optimized' is troubling to environmentalists. Only uncompensated welfare losses are considered as 'externalities' according to economic theory, so that although physical pollution may occur, it will disappear in economic terms if the loss of welfare is accompanied by compensation by the polluter (Pearce & Turner, 1990, p. 62). Furthermore, even if economic pollution exists, economists believe that "it is unlikely to be the case that it should be eliminated (Pearce & Turner, 1990, p. 62). For example, if the economic benefits provided by a pulp mill are determined to outweigh the uncompensated impacts resulting from the mill's pollution, the pollution is considered profitable enough to be acceptable.

Environmentalists believe that there are better criteria and better institutions (other than the market) for making decisions about the environment. Other criteria suggested include equality of resource distribution, rights over different aspects of the environment, interests of other species, and impacts on future generations, among others (Jacobs, 1997).

Rather than using the market as the institution through which environmental choices are made, environmentalists suggest a political or collectively organized process, which can express values that cannot be captured through the willingness to pay criteria of the market. The rationale for this is that the environment is *not* a commodity which is traded and individually consumed like ordinary 'produced' goods and services, but is a classic example of a public good, whose 'consumption' is indivisible (Jacobs, 1997, p. 74). On this basis, environmentalists claim that it is impossible to give the environment a price in the hypothetical markets created by environmental economists.

Even some of the strongest advocates of markets recognize the value of leaving environmental decision-making to political procedures, rather than to "the impersonal workings of ordinary market forces" (Ruff, 1970, p. 32). While Ruff argues vehemently in favour of "putting a price on pollution", he recognizes pricing as a tool to be used to achieve a goal determined by public policy. In an example he gives of protecting the quality of a German river, he shows how science can be used to determine a desired outcome and pricing can be used to reach it. In this case, laboratory tests determine acceptable levels of various pollutants according to their influence on fish health), and construct an index which measures the amount of pollution from each source in terms of its intensity. Polluters are then charged accordingly. (The index is corrected as necessary, if water quality is not satisfactory.) Note that this process is not to be confused with the standard neoclassical view that pricing itself can determine decisions, by putting a monetary value on environmental goods and services, and letting the market decide the best outcome.

Jacobs finds support for the environmentalist critique of economists' hypothetical markets and valuation techniques for environmental goods and services. In valuation exercises intended to determine "willingness to pay" for a particular environmental attribute, he notes that up to 50% of participants have simply refused to answer, arguing that the exercises are an inappropriate method of expressing their environmental values (Jacobs, 1997, p. 79). (See Jacobs, 1997 and Ackerman & Heinzerling, 2004 for more elaborated critiques of the neoclassical perspective.)

Finally, and of particular relevance to the case study of this thesis, is the failure of economists to acknowledge the influence of power on distributions of costs and benefits in their standard model of 'social efficiency'.

Power and the Distribution of Environmental Impacts

In determining social efficiency, neoclassicists consider only overall costs and benefits, without regard to their distributions. From the standpoint of society at large, neoclassicists argue, production is at an efficient level when marginal benefits equal marginal production costs; that is, when net benefits are maximized, *no matter to whom those net benefits accrue* [authors' italics] (Field & Olewiler, 2002, p. 69). In a similar vein, the economic concept of optimal pollution is based on the assumption that the gains or losses of one party should not be weighted more than another's (Pearce & Turner, 1990, p. 62). The benefits to one party from environmental destruction are weighted equally to those to another from environmental protection, and the benefits to the rich are weighted equally as those to the poor.

Critics of the neoclassical perspective argue that these economists exclude 'real-world' variables of power and politics from their analysis. These critics claim that inequalities in power and wealth not only affect the distribution of impacts, but may also influence the overall *magnitude* of impacts. These arguments, elaborated upon below, apply not only to environmental degradation but to other forms of social welfare, such as labour conditions.

The economists Pigou (1932) and Kapp (1971) discuss how power differentials (what Kapp refers to as "bargaining asymmetries") between employers and unorganized labour, affect worker welfare. Pigou (1932) observes that an employer usually stands to suffer a smaller loss of well-being than an individual worker, when a bargain fails, partly because the employer is wealthier and partly because he has other workers available to do the same job. As a result, the employer is generally in a better position to "push things to extremes" (p 559).

Kapp (1971) further notes how the relatively weak bargaining position of workers makes it difficult for them to claim compensation for the impairment of their health in the production process, where they work in hazardous conditions (p. 49). This is particularly the case in times of widespread unemployment or surplus labour situations. Employers will be more reluctant to consider harm to workers, where it is easy to find new labourers to replace worn out workers (Kapp, 1971, p. 49). Furthermore, Pigou (1932) observes that there is a positive correlation between unfair (low) wages and long working hours, in that, if an employer is able to exploit his workers in the matter of wages, "the poverty, which he thus induces in them, will often make them *willing* [author's italics] to work for longer hours" (p. 467). The disparity in bargaining power between workers and

employers is of particular concern to the extreme poor, whose poverty makes them easy victims to the superior bargaining power of employers (Pigou, 1932, p. 610).

James Boyce (2002) makes similar arguments about the importance of bargaining power, with respect to environmental degradation. He argues that when power variables are incorporated into standard economic theory, the disproportionate imposition of impacts on the poor or powerless can be seen as the *natural outcome of a competitive market system*. Boyce (2002) explains power as a function of individual characteristics (such as wealth, gender, ethnicity and race); the number of individuals involved; and the political framework in which the relevant activity operates (p. 36). His argument is elaborated on below, and contrasted with standard economic theories of pollution, which ignore power differentials.

As already noted, in standard economic cost-benefit analysis, environmental economists determine that the 'socially efficient' level of environmental degradation occurs where marginal benefits equal marginal costs. Although these economists recognize the propensity of producers to pollute, they assume that private bargaining, government intervention, or some other type of interference will reduce the level of environmental degradation closer to a more socially efficient level" (Boyce, 2002). A famous example of one of these economic assumptions is the Coase theorem, developed by the economist Ronald Coase in 1960. It argues that property rights (the right to use a resource) are all that is necessary for reaching 'optimal' environmental protection, and that this level of protection will be achieved by private 'bargaining' between polluters and affected parties. Government intervention is considered unnecessary.

Even more appealing to neoclassicists, the theorem mathematically "proves" that a socially efficient equilibrium [ie. optimal pollution] can be reached by parties bargaining over compensation and actions, *independent of which party has the property rights"* (Field & Olewiler, 2002, p. 426).

This theorem has attracted considerable attention by economists, since at first it would appear that 'rights' would make a difference to pollution levels. Where the polluter has property rights, it would be expected to freely pollute, while if the pollutee had the rights, it would be expected to stop the polluter. However, according to Coase's theorem, whoever has the rights to the use of the river will be bribed by the other party (either to prevent or "allow" a certain level of pollution) until the socially optimal level is reached. This theorem considers both polluters and pollutees as victims and equally deserving of benefits (Field & Olewiler, 2002). Using the example of a factory polluting a river which affects a fishery, under the Coase theorem, the fishery is also considered to inflict damages on the factory because its presence makes it necessary for the factory to control its emissions.

Most economists recognize that there are few real-world examples of Coasian bargains, suggesting that there are either obstacles to them or that the theorem is "not rooted in real-world economics" (Pearce & Turner, 1990, p.74). Some further observe that "the decision to confer the property right on a party results in a transfer of wealth to that party" (Tietenberg, 2004, p. 75). However, while recognizing an inequality in gains, economists do not consider the effect of power inequalities on the outcome.

Boyce (2002) argues that power differentials would affect not only the welfare of each party, but the ultimate level of environmental degradation. Using what he terms a

"power-weighted social decision rule", Boyce argues that when 'the losers' (sufferers) are less powerful than 'the winners' (polluters), environmental degradation exceeds the economically defined socially efficient level. Alternatively, when the sufferers are more powerful than the polluters, the reverse occurs. The 'socially-optimal' situation would be expected to occur only when power is equal. Boyce also points out that situations in which winners are more powerful than losers can be expected to occur more frequently than the reverse, since power correlates positively with wealth. In other words, those in a position to pollute generally have higher incomes than the sufferers of their pollution.

Using the previous example of the factory and fishery to illustrate Boyce's power-weighted social decision rule, suppose the factory is a large, profitable plant and the fishery is made up of low-income fishermen. Without strong government intervention (which is often itself influenced by power interests, particularly in socially undemocratic regions), it is doubtful that the socially optimal scenario would result. In the case of private bargaining, should these fishermen have the "rights" to the river, it is unlikely that they could convince the more economically powerful plant to 'bribe' them to accept pollution. Alternatively, should the factory have the rights, it is unlikely that the fishermen could *afford* to 'bribe' them.

Based on this 'power weighted' theory of bargaining, Boyce (2002) concludes that inequality is positively correlated with environmental degradation due to the ability of more powerful 'winners' (people who derive net benefit from economic activities) to impose costs upon less powerful 'losers' (people who bear net costs.) "All else equal, *greater inequalities of power and wealth lead to more environmental degradation*" [my italics] (p. 34).

The economic goal of social efficiency raises additional concerns over equality. First of all, keeping in mind that the benefits of an economic activity are based on individual preferences, which are in turn, based on consumers' willingness to pay, the "willingness to pay" criterion has important implications. As Jacobs (1997) notes, "individual preferences are a function of income – the 'willingness to pay' criterion cannot be divorced from ability to pay" (p. 76). In other words, the preferences of the wealthier will be disproportionately represented, since they have a greater ability to pay. Boyce (2002) illustrates how income equality could affect ability to pay and subsequent economic value of an environmental asset. Using the example of deforestation, he notes that the purchasing power of relatively rich consumers increases the 'benefit' from converting tropical forest to cattle ranches, by raising market demand for beef. At the same time, as this conversion takes place, the incomes of those depending on the forest decline. The result is a decrease in the forest dwellers' "ability to pay" for the forest's protection. In other words, the benefits of deforestation increase with rising inequality between 'winners' and 'losers'. This same argument could be made using the example of the factory and fishery, in that increased pollution would cause further inequality by harming the fishermen's livelihood.

It should also be observed that relative wealth influences not only "willingness to pay" for welfare benefits such as environmental protection and good health, but "willingness to accept" losses of these benefits Critics argue that those with low incomes and little power will be compelled to sell their health and well-being cheaply, relative to the more affluent and powerful.

Within the environmental justice literature, there is empirical support for the relationship between power disparities and distributions of environmental impacts. Researchers studying the distributional patterns of environmental impacts note how landfills, incinerators, and toxic factories are disproportionately located in low-income or minority areas (Center for Investigative Reporting & Moyers, 1990).

Introducing power and "bargaining asymmetry" into the cost-benefit equation serves to explain how it has been the poor and powerless who have had to bear the greatest impacts. This is not done maliciously but simply as a "side-effect" of the pursuit of the usual economic aims of production and consumption at the least cost (Boyce, 2002, p. 125).

The next section shows how power differentials within the global economy can encourage a shifting of environmental impacts from economic actors in the developed world to less powerful citizens of the developing world.

The Global Economy and the Shifting of Environmental Impacts

> *"...many forms of pollution cannot be isolated, buried, burned, or ignored in one place without being felt elsewhere in time and place" (Tabb, 2002, p.161)*

Increased global economic integration is characterized by changes in the global production system, namely "the rise of increasingly complex transnational commodity chains" (Conca, 2002, p. 135). A transnational commodity chain refers to the global dispersion of economic activities involved in the production and consumption of a product, such as resource extraction, component manufacture, assembly, packaging, marketing, advertising, retailing and other services. 'Post-consumer' activities, such as

waste management are also becoming absorbed into this global network, as will be discussed in more detail further in this paper.

There is active debate on the effects of rising global economic integration (primarily trade) on both the levels and distribution of environmental degradation (Bhagwati, 1993; Daly, 1993). The economic theory which currently dominates argues that global trade increases living standards, which provides the economic basis for reduced pollution. Chapman, Agras, and Suri (1999) reviewed over 40 papers on trade and environment, noting that only five held the position that trade is likely to increase overall pollution levels (p. 278). Critics of the "trade is good for the environment" perspective note the fallacy of this economic rationale, when the environment and resource content of trade between nations is excluded from analysis. They suggest instead that the positive relationship between a nation's income and level of environmental protection can also be the result of a *shifting of environmental impacts from wealthy to poorer nations,* through international trade.

In contrast to Boyce, who views inequality as a significant cause of environmental degradation, neoclassicists often blame poverty (Boyce, 2002, p. 5). They argue this on the basis of what is known as the "Environmental Kuznets curve". This is a statistical relationship between an indicator of environmental quality and gross domestic product. The standard inverted-U shape indicates that as per capita incomes of a country grow, environmental quality may initially decline, but as per capita income rises further, environmental quality begins to increase, reflecting a country's growing demand for higher levels of environmental quality (Field & Olewiler, 2002, p. 429). On the basis of

this relationship, economists argue that further global economic integration will ultimately aid environmental protection due to rising income levels.

In contrast, some environmentalists argue that the global economy has expanded the space into which environmental impacts can be shifted from powerful to less powerful market actors. In today's economy, commercial activities are no longer tied to specific features of a given place – a given community, labour force, terrain, or ecosystem, and virgin materials for production can be extracted from any nation (Gould et al., 1996). Thomas Princen (2002b) describes this economy as a simulated "frontier economy." He characterizes a "true" frontier economy as one where resources and pollution sinks are abundant and recipients of external costs [impacts] are few or have little power; and where firms can claim rights to resources but don't need to accept responsibility for the resource. Such an idealized economy provides little incentive for businesses to "internalize costs", in the language of economists. "Where firms continually face a binary choice between efficiency seeking and cost externalizing", Princen (2002b) claims, "in a frontier economy, they tip toward cost externalizing" (p. 105).

MacNeill, Winsemius and Yakushiji (1991) have developed the concept of 'shadow ecologies,' to refer to the global shifting of environmental impacts:

> At one time, the ecological hinterland of a community was confined to the areas immediately surrounding it. Today, the major urban industrial centers of the world are locked into complex international networks for trade in goods and services. The cities of the economically powerful Western nations draw upon the ecological capital of other nations to provide food for their populations, energy and materials for their economies, and even land, air, and water to assimilate their waste by-products. This ecological capital, which may be found thousands of miles from the regions in which it is used, forms the "shadow ecology" of an economy (p. 58).

There is growing evidence that environmental impacts are being shifted from advanced, industrialized to (less powerful) developing nations, through trade. In other words, rich nations are exporting pollution (importing "environmental services") when they consume imported goods. Developed countries consume two-thirds of all primary commodity exports, the majority which come from developing nations (Muradian & Martinez-Alier, 2001, p. 286). In Germany, 35% of resource consumption is incurred abroad, in Japan, 50%, and in the Netherlands, 70% (as cited in Sachs, 1999, p.151)

Muradian and Martinez-Alier (2001) note that economists' Environmental Kuznets Curve does not take into account international trade. These researchers examined South-North material flows from 1971 to 1976 and 1991 to 1996, concluding that "the North's economic growth goes together with increasing consumption of non-renewable resources coming from developing nations" (p. 289). European imports for the six most polluting sectors (iron and steel, non-ferrous metals, industrial chemicals, petroleum refineries, non-metallic mineral and pulp and paper products) were found to originate in developing countries (p. 290). Impacts are felt by less developed industrializing countries in the way of resource depletion and pollution from intensive initial processing, as well as health impacts to workers, while consumers in rich nations benefit from low cost goods and a cleaner local environment (Chapman, Agras, & Suri, 1999). Muradian and Martinez-Alier (2001) also note that imports of semi-processed materials have increased more than imports of raw materials over the past several decades, implying additional environmental impacts associated with processing (p. 289).

Chapman et al. (1999), cite the relationship between GNP and energy efficiency as another example of the shifting of impacts. Economists note that energy used per

dollar of GNP has declined for member nations of the Organization for Economic Co-operation and Development (OECD), claiming this as evidence that economic growth results in environmental improvement. However, when trade is accounted for, Chapman, et al. (1999) suggest that improved energy efficiency is better attributed to a shift in energy-intensive manufacturing from OECD countries to industrializing nations, as "the decline in energy per real dollar of GNP in OECD countries has been exactly offset by an increase in energy intensity elsewhere" (p. 278).

Corey Lofdahl (2002) develops a more elaborate statistical model of 'trade connected GNP' which incorporates the environmental impacts of trade. Testing his model with a case study of deforestation, he also finds fault with the 'Kuznets' relationship. Contrary to the usual economic finding that forest cover increases with GNP per capita, Lofdahl finds that forest cover actually *decreases* with GDP when trade is considered. In other words, more trade means greater deforestation. Furthermore, the relationship between 'trade connected GNP' and forest cover is statistically stronger than GNP per capita. Lofdahl (2002) concludes that "trade and growth affect the environment negatively" and that trade may serve as a mechanism for the exportation of environmental impacts by high GNP countries" (p. 125).

Finally, as noted above by Chapman et al. (1999), the shifting of polluting industries to developing nations not only results in environmental impacts, but associated impacts to worker welfare. For example, 63% of 1407 multinational enterprises[1] investigated in Shanghai had hazardous materials or production processes, and 14% of 239, 995 workers investigated had been exposed to various occupational hazards

[1] Multinational enterprises investigated included Chinese-foreign joint ventures, Chinese-foreign cooperative enterprises, and wholly foreign-owned enterprises.

(Christiani, Tan, & Wang, 2002, p. 363). A separate survey of multinational enterprises in one of China's special economic zones (Shenzhen) in Guangdong Province, found overtime hours to be frequent, and exposure to hazard levels to be much higher than maximum allowable concentrations (Christiani, Tan, & Wang, 2002, p. 363).

The above analysis has shown how the 'interconnectedness' of economies can enable a shifting of environmental impacts from more powerful to less powerful regions, and how this shifting can also result in impacts to human health and welfare. The global integration of economies and commodity chains has one more important implication for environment decision-making that is relevant to this paper. This concerns the effects of the "distancing" of economic activities on the accountability of decision-makers.

Global Economic Integration and Distancing

The global complexity of economic activities tends to obscure impacts as they become distanced from decision makers. According to conventional economic theory, economic actors tend to ignore the effects of their transactions on others. Almost 30 years ago, David Pearce (1977) noted how the degree of disinterest of an actor is likely to be greater the further away in time or distance the effect occurs (p. 169). Thomas Princen (2002b) discusses this concept of "distancing" at length. He refers to the concept as the separation between primary resource consumption decisions and ultimate consumption decisions occurring along four dimensions - geography, culture, bargaining power, and agency (p. 116). The agency dimension refers to the number of intermediaries that are found between the primary producer and ultimate consumer.

Distancing results in a severing of ecological and social feedback as decision points along the supply chain are increasingly separated. This severing of feedback cuts decision makers off from a contextualized understanding of the consequences of their choices (Princen, Maniates, & Conca, 2002, p. 16). In other words, decision-makers are less likely to be both aware and concerned about the social and environmental impacts of their decisions, when those affected live in far off places.

This distancing effect is further exacerbated in a global economy. Where production and consumption activities are spread over large geographic distances, further harm is done to the feedback system that informs economic actors of the impacts of their decisions. Distant buyers and consumers of a product, (for example rice, fish, or timber) have no way of knowing what the effects of their economic decisions are on the resource or production environment. The difficulty in obtaining and communicating information on impacts can be attributed in large part to the complexity in our economic system. This system is comparable to an ecosystem, where the uncertainties of ecological information arise not only from a lack of research, but also from system complexity (Martinez-Alier, 2002, p. 33).

By making impacts 'invisible' to the beneficiaries of an economic activity, distancing greatly reduces any accountability on the part of producers and consumers: "When critical resource decisions are made by those who will not or can not incur the costs of their decision, accountability will be low and what gets counted is likely to be financial capital, not social or natural capital" (Princen, 2002, p.129). In other words, distancing may further intensify the shifting of environmental impacts.

Summary

This chapter has attempted to explain environmental problems and their distribution from two main perspectives – that of neoclassical economists and that of environmentalists. Economists explain environmental degradation in terms of externalities, and advocate policies which aim towards an outcome where net benefits outweigh net costs and pollution is 'optimized.' These theorists tend to ignore the distribution of costs and benefits in their analysis, and in fact the strictest logic encourages the unequal distribution of impacts on the basis of economic efficiency.

In contrast, critics of the economic perspective blame the strict economic logic of the marketplace for intensifying environmental problems. They argue that market forces shift environmental impacts through the global economy, often taking advantages of inequalities in power and wealth. They also note that such distancing exacerbates environmental problems, by reducing accountability.

The next chapter will adopt the environmentalist perspective to analyze the specific problem of waste.

Chapter 2: The Environmental Problem of Waste

"Everyone wants consumer goods but nobody wants the associated waste" (Tammemagi, 1999, p. 225).

This chapter will use the theoretical position adopted from Chapter 1 – that of the 'environmentalist' to explain the environmental problem of municipal solid waste, the subsequent development of a market remedy to the problem, and the ultimate subversion of environmental concerns by the economic forces of the global market.

The Environmental Impacts of Waste

Municipal solid waste refers to waste from residential, commercial, institutional and industrial sources, excluding that from industrial processes (as cited in Spiegelman & Sheehan, 2005, p. 2). The impacts of waste are both direct and indirect. Direct impacts result from disposal practices. In 2001, 70% of U.S. municipal solid waste was disposed, with 80% of this landfilled, and the remainder incinerated (Spiegelman & Sheehan, 2005, p. ES-2). It has been noted that there are virtually no incinerators, no landfills, and no known waste disposal methods that do not release pollutants (Center for Investigative Reporting & Moyers, 1990, p. 112). Landfill impacts include greenhouse gas (GHG) emissions and groundwater contamination from leachate, the liquid 'run off' from garbage. Methane and carbon dioxide, both implicated in climate change, make up a respective 64% and 34% of typical landfill emissions. Methane is a particularly potent greenhouse gas (GHG), with one molecule having approximately 30 times the

greenhouse effect of a molecule of CO^2. In 1999, 3% of Canada's GHG emissions resulted from landfills, with emissions rising nearly 18% since 1990 (Environment Canada, 2002). Landfill gas also contains components which are flammable and/or toxic, such as chlorinated organic compounds.

Unless carefully managed, leachate can also damage the environment by contaminating nearby water sources. Among the variety of toxic and polluting components contained in leachate are trace organic compounds of known toxicity such as benzene, dioxins and furans (Williams, 2002, p. 164).

The alternative method of disposal, incineration is no better, creating air pollutants as well as hazardous waste from ash residue. Air emissions from burning waste reflect typical waste composition, which includes significant concentrations of heavy metals such as cadmium, lead, zinc and chromium. Other significant emissions include particulates (dust), corrosive gases such as hydrogen chloride, hydrogen fluoride and sulfur dioxide, and dioxins and furans (Williams, 2002, p. 160). Flyash captured in pollution abatement systems may be highly polluted, sometimes attaining the status of hazardous waste. High heavy metal concentrations in ash residues are of concern when disposed where leaching may be a source of groundwater contamination (Williams, 2002).

Impacts from disposal are not the only environmental concerns with waste. The disposal of waste also implies 'hidden impacts' incurred during the life cycle of the waste good. These impacts include the destruction of landscapes and habitat, depletion of non-renewable resources, and air and water pollution associated with resource extraction, materials processing, transport and marketing activities. Raw resource extraction and

processing are recognized to be "the most polluting, energy-intensive and ecologically destructive of all human endeavours" (Durning, 1992, p.89).

Furthermore, the volume of municipal solid waste continues to grow. Waste generation generally increases at the same rate as a country's GDP, contrary to the "inverted-U shape" observed in the Environmental Kuznets curve (see Chapter 1). A 40% growth in GDP among OECD countries, between 1980 and 1999, corresponded to a 40% increase in municipal waste (Environment Canada, 1999.) Much of this growth in waste is attributed to the growth of product (versus organic) waste. According to US EPA data, product waste more than tripled between 1960 and 2001, growing by 38% between 1980 to 1990 and 25% between 1990 to 2001 (Spiegelman & Sheehan, 2005). This growth of product wastes has important implications on disposal impacts. Tens of thousands of different chemical compounds are produced every year as the basic ingredients for virtually every consumer product manufactured today (McGinn, 2002). When these products are disposed, toxic compounds can leach into soil and groundwater. In the 1970's, 20% of the United States 'Superfund' sites (priority chemically contaminated sites) were municipal landfills (Sheehan & Spiegelman, 2005). This pollution also results in health risks to nearby communities.

Explaining the Problem of Waste

In neoclassical terms, solid waste is a problem because of defects in the pricing systems that govern material flows (Field & Olewiler, 2002, p. 374). Market failure arises mainly because disposal costs are not absorbed by the polluter (producer or consumer), but by municipal taxpayers. Since producers do not pay for the ultimate waste disposal

costs of the goods they produce, product prices do not reflect full social impacts. In addition, consumers typically do not pay for disposal on a unit basis (ie. according to the amount of waste they generate). Finally, the environmental impacts of disposal, as well as social impacts from illegal dumping of wastes and littering, are paid by neither producers nor consumers (Field & Olewiler, 2002, p. 372).

For economists, the result of the above externalities is a 'socially inefficient' consumption of goods, so that more waste is generated than is efficient in a perfect market.

Environmentalists do not disagree that failures in the pricing system are important contributors to the waste problem. Some believe that the municipal solid waste management system has acted as a "perverse subsidy" to the production of short-lived products, facilitating excessive material flows (Spiegelman & Sheehan, 2005). However, irrespective of price distortions in the product cycle, environmentalists do not generally believe that a 'perfect' market would achieve appropriate levels of environmental protection. Nor would any reliance on purely economic criteria. They believe instead that democratic-based policy intervention is needed to protect the environment (Chapter 1).

Environmentalists criticize the basic subjection of environmental to economic criteria in our production-consumption cycle. Many attribute excessive waste generation to the economic logic of production and product design. They blame characteristics such as disposability, rapid obsolescence, and irreparability on the high disposal rates found in industrialized nations (Durning, 1992). Durning (1992) argues that rapid product obsolescence is a logical response to the relative costs of production – labour is expensive

and mass production takes less time per worker than repair (p. 96). Susan Strasser (1999) notes that the growth of markets for new products has come to depend in part on the continuous disposal of old things.

Furthermore, new products and packaging enter the market, largely unregulated in terms of the environmental implications of their design and composition. Whether or not a more durable or re-usable form of a product exists, there is nothing to stop a company from introducing a short-lived or single-use alternative into the marketplace. Similarly, there is nothing to prevent the introduction of products composed of multiple materials – sometimes hazardous - making products difficult and expensive to disassemble and repair or recycle. These fundamental characteristics encourage high waste levels, according to environmentalists (Strasser, 1999; Durning, 1992).

Finally and of particular relevance to the case study of this thesis (Chapter 4), some environmentalists explain waste not only in terms of overconsumption, but as a distributional problem. Environmental justice advocates note the unequal distributional impacts of waste. Consistent with the explanations of the shifting of impacts outlined in Chapter 1, researchers have noted how waste facilities are located in sites where citizens are less powerful, so that the environmental and health impacts often fall disproportionately on lower class or minority communities (Gould et al., 1996).

The Global Shifting of Waste

There is also considerable evidence that the global trade network provides a mechanism for the shifting of disposal impacts. Gould et al. (1996) note that unprocessed wastes can be shipped abroad if local communities reject local landfills or incinerators (p.

160). In the 1980's, Greenpeace uncovered several high profile cases of toxic waste exports from developed to developing countries (Center for Investigative Reporting & Moyers, 1990; Gould et al., 1996). The most infamous was the voyage of the *Khian Sea*, a ship filled with 14,000 tons of toxic ash from the incineration of Philadelphia's municipal waste. The ship spent more than 27 months at sea, approaching five continents in search of a port that would accept its waste. The fate of this waste remains unknown. (Center for Investigative Reporting & Moyers, 1990, pp. 17- 30).

Remedies to the Waste Problem

Environmentalists advocate a hierarchy of options for reducing the environmental impacts of materials consumption - the familiar "reduce", "reuse", and "recycle." From an environmental perspective, the first of the "3R's" (reduce) is considered the most effective since it prevents the consumption of a waste-producing good in the first place, avoiding all associated life cycle impacts. Similarly, the second "R" (reuse) also prevents consumption by presupposing that a specific good, already in use, can be used in place of a new good. Recycling is on the third rung on the 3R's hierarchy, and is considered to be the preferred waste management option, where reducing and reusing are not appropriate. As well as reducing the impacts of waste, it reduces the environmental impacts and energy required by raw resource extraction and processing. Compared to landfilling or incineration, the benefits of recycling are considered clear and substantial, as evidenced by the energy saved and the greenhouse gas emissions avoided by remanufacturing recyclables rather than producing virgin materials (Barlaz et al., 2003, p.55)

Environmentalists have long supported recycling efforts. Gould et al. (1996) note that, in the 1980's, the strongest push for recycling came from local political resistance to landfill due to fears of toxic and other pollution (p. 151). Recycling programs, in fact, have their roots in the counterculture of the late 1960's and early 1970's when activists organized voluntary recycling centers as part of social and cultural movements, rather than small businesses (Strasser, 1999, p. 283). At the grassroots level, activists have considered recycling to be integral to an alternative paradigm of sustainable development, characterized by small-scale community-based industries, based around local production from local resources (Gandy, 1994, p. 18). Some proponents have suggested that recycling can serve as a strong force for decentralizing the economy, based on the logic that recycling-based manufacturers need to be close to their sources of materials to reduce transportation costs (Seldman, 2003, p. 60).

Economists appear to have mixed views on recycling. In the province of Nova Scotia, comprehensive recycling and composting programs have been estimated to cost the province $18 million per year more than landfill disposal (GPI Atlantic, 2004). On the basis that landfill disposal and incineration are generally cheaper methods of managing waste, and government intervention interferes with economic efficiency, free market economists argue against recycling policies. One author states that the extent of government involvement currently found in refuse-collection markets is not justified by economic criteria, and decisions about garbage and recycling collection should be left to individual households (Doren, 1999). Other examples of economic critiques of recycling are found in Tierney (1996), and several papers published by the Cato Institute, an

influential public policy research foundation which advocates individual liberty and free markets[2].

In contrast to the free marketeers, most environmental economists argue that recycling makes economic sense, when full social costs and benefits are accounted for. A full-cost accounting study of Nova Scotia's waste-resource management system estimated that recycling and composting save the province approximately $31 million to $167 million per year, when benefits such as energy savings, and air emissions reductions are taken into account (GPI Atlantic, 2004). As a result of such benefits, many environmental economists are concerned with internalizing the 'externalities' of disposal, so as to encourage recycling.

Furthermore, in comparison to the other two "R's" in the environmentalist's hierarchy, recycling is preferable economically, since it presupposes the consumption of a good, and re-introduces materials back into the production-consumption cycle. In contrast, "reducing" and "reusing" contribute little to the market economy, since these activities often take place outside of the formal economy. In discussions of remedies to the waste problem, environmental economists either make brief mention of "reduction" or fail to discuss it altogether (as in Tiettenberg, 2004). In a standard environmental economics textbook, Field and Olewiler (2001) mention "reducing the quantity of goods and services produced" as one way of reducing the quantity of raw materials extracted from the natural environment in order to reduce disposal of residual (p. 29). However, in a paragraph on this option, they refer only to slowing population growth, with no

[2] Bandow, D. (1997); Schaumburg Jr, G.W. & Doyle, K.T. (1994); Taylor, J. (1992, 1997); and Van Doren, P. (1999).

reference to per capita reduction of materials. In a later chapter, the text goes on to examine the economics of recycling in great detail (p. 374 - 387).

With support from both economists and environmentalists, recycling has emerged as a dominant remedy to the waste problem of the developed world. Curbside recycling programs are ubiquitous throughout the developed world and recycling is advocated by everyone from environmental groups, to government and big industry. In Canada, government and non-profit recycling councils promote recycling, as well as local environmental NGO's. Canadian industry groups promoting recycling include Corporations Supporting Recycling, the Environment and Plastics Industry Council (EPIC), and the Paper Recycling Association. In global political terms, recycling has become part of the world's sustainable development strategy, and was endorsed at the 1992 United Nations Rio conference. The Agenda 21 declaration calls for the promotion of "sufficient financial and technological capacities at the regional, national and local levels as appropriate to implement waste reuse and recycling policies and actions" (United Nations Conference on Environment and Development, 1992, Section 21:18).

On the surface, the 'mainstreaming' of recycling appears to be a good thing. However, when its operation is examined within the current global economy, it is clear that recycling becomes subject to the same market forces as any other industry. The following discussion shows how recycling has become absorbed into the global market system, and how such absorption threatens the achievement of its environmental and social goals.

Recycling, the Economic Criteria of the Market, and the Influence of Power

Several externalities related to waste disposal have already been noted in economic explanations of the waste problem. According to economists, additional externalities related to the product cycle also contribute to the waste problem by reducing the level of recycling below an 'efficient' level. Examples are the unpaid impacts associated with raw resources and their extraction.

Tietenberg (2004) notes that "raw materials are artificially cheap and can inefficiently undermine the market for recycled inputs" (p. 365). Furthermore, a number of subsidies on virgin materials and waste disposal activities further distort price signals. A report by the National Recycling Coalition's Policy Workgroup (1999) identified nine (US) federal subsidies, which negatively impact recycling and resource conservation, totalling approximately $3 to $5 billion annually. However, the report also concludes that the elimination of these subsidies will not address other environmental impacts, nor will it guarantee an improvement in the market demand and prices paid for recovered materials. If low recycling rates prevail in an efficient market (ie. devoid of clearly identified market failures), economists determine that "the time for recycling has not yet come" (Tietenberg, 2004, p. 312).

Should decision-making concerning recycling be based on environmental, rather than economic criteria, market failures and 'price distortions' would not be such a problem. However, the free market dictates that decisions be based on economic efficiency and the lowest-cost inputs. As a result, manufacturing industries have had no incentive to substitute virgin with secondary materials. Notable exceptions are where

economic savings result from the use of secondary materials, due to significant energy savings during processing, for example. Such is the case for aluminum and steel. Generally though, high costs of transporting and processing waste materials makes recycling uneconomical. Tietenberg (2004) notes that even when there is acute scarcity [of a virgin resource], nowhere near 100 percent of the materials are recycled; costs don't permit it! (p. 361)

The dominance of economic over environmental considerations is also evident in cases where government policies to promote recycling interfere with producer's economic interests. In cases where taxpayers bear the costs of collection, producers may welcome recycling of their products for its contribution to a greener corporate image. However, in cases where industry anticipates that they will bear costs, they will resist environmental policies. A good example is persistent industry opposition to bottle deposits for recyclables. Bottle deposit legislation has proven important in obtaining high recovery rates for beverage containers. In Canada, the average recovery rate for plastic beverage containers in provinces with deposit return programs is 75%, compared to an average of 33% in provinces without such programs (Environment and Plastics Industry Council [EPIC], 2004). However, the addition of a deposit to beverage prices is perceived as a threat to sales. Powerful industry associations, such as the Canadian organization, Corporations Supporting Recycling (CSR), have actively fought such legislation. In 1996, Pepsi, a major contributor to CSR, sponsored a lawsuit (which they ultimately lost) trying to overturn Nova Scotia's deposit system.

Governments are also victim to the logic of economic efficiency in decision-making concerning recycling. Municipalities operating collection programs are

dependent on manufacturers to buy collected materials. As a result, the existence of stable markets determine which materials are considered worthwhile to collect in municipal recycling programs. As waste management costs rise, municipalities may be forced to choose economic over environmental considerations. For example, after nine years of running an "all plastics" blue box program, in June 2004, the city of Ottawa stopped collecting plastic resin numbers 3 though 7. The municipality reportedly spent $1.17 million in 2003 to collect, process and market these plastics, which would have cost about $240, 000 to dispose (Jones, 2005).

However, as Frances Cairncross notes, "voters appear to love recycling; it seems to meet some deep human need to atone for modern materialism" (as cited in Ackerman, 1997, p.10). Under pressure from environmental groups and citizens, many municipalities choose to collect materials for recycling, rather than dispose of them at lower cost.

At the same time, most citizens are unaware of what happens to the material that they place at the curbside. Gould et al (1996) note that "one reason for the unwarranted optimism about recycling as an environmental policy is that its socially visible face is the local collection of post-consumer wastes" (p.133). However, once past the curbside, the criterion of profits rather than environmental protection becomes the basis for recycling.

The economic drivers of recycling have several consequences which may undermine environmental goals. First of all, due to poor market conditions, collected materials may end up landfilled. Where municipalities collect large amounts of materials that industry does not yet find economical, 'supply' can outstrip 'demand' in market terms. In the past, citizens have "deposited their newsprint into municipal containers,

where it was whisked out of sight by municipal trucks, which then dumped their newsprint in landfills because of market conditions" (Gould et al. 1996, p.149). The same was true at one time of plastic bags in Nova Scotia (B. Friesen, personal communication, May 3, 2004.)

As a burgeoning global market develops in secondary materials, economics may also dictate that the materials collected in municipal recycling programs are sent overseas. The subsequent section will consider the dynamics of the 'secondary materials' market on a global level, showing the influence of power and inequality on the distribution of environmental and social impacts.

The Global Market in Waste Materials

Even before waste materials are recycled, the global trade in waste already causes pollution and associated health risks. Waste is transported overseas in container ships, and vessel engines are the dirtiest combustion sources per ton of fuel consumed (Talley, 2003, p. 287). Ship emissions have been linked directly to human health risks. A study released by the California Environmental Protection Agency (Pingkuan, 2005), determined that diesel particulate matter emissions resulted in elevated cancer risk levels in the port communities of Los Angeles and Long Beach. Emissions from ship activities accounted for 73% of these emissions. Meanwhile, in the Port of Vancouver, emissions from ships were shown to be greater than all the diesel trucks and buses on the roads (Welch, 2004).

In the County of Santa Barbara, ships were found to produce one-third of the nitrogen oxides (NO_x) released each day (Welch, 2004). Nitrogen oxides contribute to ground-level ozone, (a major component of smog) which is associated with an increased

risk of respiratory disease, allergies, and asthma. In the atmosphere, they can also be converted to nitric acid, which causes acid rain.

Marine ships are also a source of carbon monoxide (CO), non-methane volatile organic compounds (NMVOC's), methane (CH_4) and nitrous oxide (N_2O). When inhaled, carbon monoxide (CO) reduces the ability to use oxygen; relatively low-level, short-term exposure is associated with cardiac diseases, and there is also evidence that CO exposure may lead to premature deaths. Volatile organic compounds (VOCs) are a group of carbon compounds that react with nitrogen oxides to form ground-level ozone. Some VOCs are carcinogenic, such as formaldehyde (produced from fuel combustion) and benzene (a component of crude oil). Methane (CH_4) and nitrous oxide (N_2O) are both considered principal greenhouse gases, contributing to global climate change.

The waste trade results in further impacts once it reaches its destination. The global impacts of waste were already touched upon with respect to the hazardous waste trade. In 1992, an international agreement, the *Basel Convention on the Transboundary Movement of Hazardous Wastes and Their Disposal* came into effect to regulate the trade in toxic wastes and to protect developing countries from unwanted toxic waste imports[3]. This regulation apparently eliminated some of the worst forms of toxic waste dumping, so that by the mid-1990's, a significant decrease was reported in the export of toxic wastes to developing countries for final disposal (Porter, Brown, & Chasek, 2000, p.108).

At the same time, exports of wastes for "recycling" steadily increased. According to Greenpeace, by the early 1990's, approximately 90% of hazardous wastes exported to developing countries were sent for 'recycling' or 'further use', rather than disposal,

[3] cf. Clapp (2001) and Porter et al, (2000) for an excellent review and critique of the history and politics of this agreement.

compared with only 36% in the period between 1980 and 1988 (as cited in Porter, Brown, & Chasek, 2000, p.107). In conjunction with local NGO's in developing countries, Greenpeace carried out extensive research on hazardous waste recycling throughout the 1990's, examining over 50 recycling operations in developing countries (Porter, Brown, & Chasek, 2000, p.107). In addition to pollution impacts, the investigators noted serious health problems in these operations, noting that much of the imported waste could not even be recycled, and even after recycling, hazardous by-products remained behind, leaving toxic waste that required disposal. Mercury recycling, lead recycling (from used car batteries), and waste plastics recycling, were some of the cases investigated.

Health Impacts of the Recycling Trade

One mercury-recycling facility investigated was Thor Chemicals, a British owned plant in Cato Ridge, South Africa, which received imported mercury waste from the United Kingdom and the United States during the late 1980's. Mercury waste by-products and mercury-laced incinerator ash were reportedly dumped into the surrounding landscape, causing soil and water contamination. In a river downstream from the plant, used by locals for cooking, washing and bathing, concentrations of mercury were found to be 1.5 million times higher than the standard set by the World Health Organization (CIR & Moyers, 1990, p. 2). In 1992, nearly one-third of Thor workers were hospitalized with symptoms of mercury poisoning, others were permanently disabled, and at least two died (Clapp, 2001, pp. 62-63)

Used car batteries are another well-documented case of waste exports to developing nations, with the lead from these batteries reclaimed by smelters. Lead is known to be "one of the most inherently dangerous substances on earth," causing harm to

the brain, nerves, kidneys and reproductive system (CIR & Moyers, 1990, p. 67). This toxicity is well known by the EPA, which declared a battery-recycling plant in Pennsylvania to be a "Superfund site" (one of the nation's most dangerous hazardous waste sites) in 1987, two years after the plant went bankrupt (CIR & Moyers, 1990, p. 66). In the US, the number of lead smelters was reduced by half, from 1980 to 1986. During this same period, batteries from the US, Australia, Japan, Canada and the UK were exported to Brazil, Mexico, Indonesia, the Philippines, Thailand, and Taiwan, for recycling (Clapp, 2001, p. 64). In Brazil and Taiwan, lead-recycling plants were investigated, revealing lead contamination, not only in workers, but in local residents. Lead levels of workers were shown to be as much as two to three times acceptable levels, with workers complaining of classic symptoms of chronic lead poisoning, such as headaches, dizziness, nausea, and weakness. In the case of Taiwan, children in a nearby kindergarten school were found to have elevated lead levels as well, causing Taiwan's EPA to ban battery imports in 1990 (CIR & Moyers, 1990, p. 73).

In 1994, after viewing evidence from environmental NGO's as to the unsafe conditions of disposal and recycling in developing nations, a full ban was proposed on waste exports from OECD countries to non-OECD countries (Secretariat of the Basel Convention, n.d., Decision II/12). However, the recycling industry launched a global campaign against the ban, using the economic argument that "a global free market in recyclable materials is the best way to achieve environmental preservation" (Clapp, 2001, p. 85). They argued that the ban could seriously harm the prospects of developing countries achieving sustainable development, due to potential job losses, and threats to

free trade which they claimed to be "a direct attack on growth, which is essential for sustainable development" (Clapp, 2001, p. 89).

The ban was ultimately adopted as a formal amendment to the Basel convention, in 1995 (Decision III/1, Basel Secretariat). This decision will come into effect after ratification by 62 of the delegates at COP-3. As of August 24, 2005, 58 countries have ratified the amendment.

The Basel Action Network (BAN), established in 1998, as an offshoot of the Greenpeace Toxics Campaign, continued to document the health and environmental impacts of this trade, most recently focusing on the trade in electronic waste. In 2002, together with the Silicon Valley Toxics Coalition (SVTC), BAN released a high-profile report on the recycling of electronics in China, which documented environmental and health impacts. In the summer of 2005, Greenpeace released a follow-up report based on more comprehensive assessment of more than 70 samples from electronic waste sites in China and India (Brigden et al., 2005). Analysis showed significant levels of heavy metals and hazardous organic compounds in the samples. Examples are lead, cadmium, mercury, antimony, polychlorinated biphenyls (PCBs), polybrominated diphenyl esters (PBDEs), nonylphenol (NP), triphenyl phosphate (TPP), and polychlorinated naphthalenes (PCN's). These compounds have both short-term and cumulative health effects on humans ranging from organ and nervous system damage, endocrine disruption, dermatitis and increased cancer risk (Brigden et al., 2005).

Summary

As reflected in Chapter 1, neoclassical theorists suggest that the market should decide the appropriate level of environmental protection, and that price distortions are to blame for current environmental problems. Their critics argue that environmental problems are better explained in terms of the market's sole reliance on economic criteria. They also offer an explanation for the distribution of environmental, as well as social impacts, explaining them in terms of a shifting from more powerful to less powerful economic agents. Finally, they use empirical evidence to demonstrate how international trade can act as a mechanism to shift welfare impacts from rich to poor nations.

In this second chapter, these theoretical arguments have been extended to the problem of waste and the remedy of recycling. This chapter has shown how the absorption of recycling into the global marketplace subjects it to the same economic forces that shift environmental and health impacts to developing nations. This more focused literature reveals the danger in allowing the strict economic criteria of the market to manage environmental problems.

The case study to follow will add to this literature by illustrating the above concepts as they are currently operationalized in the world economy. It will also explore the complexity of a single commodity chain, showing how the separation of production and consumption activities exacerbates environmental problems by re-distributing impacts to those unable to resist them; and by distancing and obscuring impacts; in other words, making them 'invisible' to the beneficiaries of an economic activity, and to the regulators of that activity.

Chapter 3: Methodology

In Chapter 1, I elaborated on explanations for environmental problems by economists and their critics. I then explored some of the forces that shift impacts, namely market forces (driven by competitive business strategy) and inequalities in power and wealth. I suggested that these factors, operating within today's global economy, can result in the distancing of impacts to less powerful actors in other nations, and that trade can act as a mechanism for the shifting of impacts. In Chapter 2, I focussed on the environmental problem of waste and its management by market forces.

I am using a case study of plastics recycling to test the theory presented in Chapters 1 and 2 concerning the distancing of impacts through the global economy, in response to market forces and power inequalities. The study involved research in Canada, Hong Kong, and the province of Guangdong, China.

My hypothesis is that the economic criteria of the global recycling market encourages the shifting of impacts of plastic wastes from more powerful to less powerful citizens. A secondary hypothesis I am testing is that the integration of plastics recycling activities into complex global trading networks impedes accountability.

Methodological Approach

Rationale

In qualitative research, a case study is used to examine a particular system (an event, a process, a program or several people) bounded by time and or place (Creswell,

1998, p. 249). The 'case' in my study is best understood as a process[4]. This process is the plastic waste trade, more specifically, the export of post-consumer plastic waste from North America (Canada and the United States) to Asia, and its recycling in Guangdong, China.

John. W. Creswell (1998) distinguishes between two main types of case studies, those that are intrinsic and those that are instrumental. An intrinsic case study is used when the focus of the research is on the case itself, because of its "intrinsic or unusual" interest. The example Creswell gives is his own case study of a campus response to a student gunman. In contrast, in an instrumental case study, the focus is on a specific issue, and the case becomes a vehicle to better understand the issue (Creswell, 1998, p. 250).

The case study of my thesis is instrumental in these terms. It is intended to focus on the shifting and distancing of impacts, rather than on any exceptional aspects of the plastics waste trade itself. Data collected in the case relate to the broader research issues of the thesis. These issues include environmental and social impacts, market forces, and inequalities in power and wealth. It is difficult to communicate these theoretical concepts in concrete terms, while it is also important that theory be 'tested' against real-world behaviour. An in-depth exploration of one global industry bridges the gap between the abstract world of academia and reality, by opening a small window into the socio-economic and environmental nature of impacts in our global economy. The case study serves as one example that may be repeated for many different places, waste commodities and commodity chains.

---

[4] Process is defined as "a series of actions taken towards achieving a particular end" (*Oxford dictionary*, 2001).

I chose to conduct a field study, for two main reasons. The first was due to the absence of secondary data on plastics recycling in China, leaving few alternatives, other than primary data collection in the field. Secondly, and importantly, I wanted to give voice to some of those who bear the impacts of overconsumption. Environmental impacts are often referred to in impersonal terms, akin to mathematical problems on global balance sheets. My intent was to contextualize and humanize the concept. Field research was the only methodological approach suited to this objective. As Singleton et al. (1988) point out, "a major reason for doing field research is to get an insider's view of reality" (p. 297). In other words, field research is not simply a means of collecting impersonal data but a means of understanding how others live and work. Field research in China enabled me to explore the human face behind some of the environmental impacts that are shifted through the economy.

Research Design

Many of the elements of my research design were worked out during the course of my study, which is typical of the nature of field research. Design for field research "is necessarily emergent rather than predetermined," according to Singleton et al. (1988, p. 305). The observed setting is not under the researcher's control and its activities generally are not known to the researcher before entering the field. This was definitely the case in my research. It was difficult for me to anticipate the conditions I would face, with so many unknowns, including the distribution, size and characteristics of factories, ease of observing activities, and accessibility of workers.

Sampling Strategy

Sampling was one dimension of my research design that was emergent rather than predetermined, since my sites were determined more by circumstance than formal selection, once I arrived in Asia. I used a non-random sampling strategy, meaning that all cases in the population did not have equal probability of being included in the sample. Plastics recycling facilities are dispersed throughout China, an enormous country. My samples were limited to Guangdong province, and to those which I could locate within the province, through 'opportunistic' means. According to Miles and Huberman (as cited in Creswell, 1998) opportunistic sampling involves following new leads and taking advantage of the unexpected (p. 119). It is important to note that the sites that I visited may not be representative of all plastics recycling facilities in China.

Theorists have pointed out some of the weaknesses of non-random sampling strategies, namely that this method does not control for investigator bias in selection, and it is "impossible to calculate sampling error or to estimate sampling precision" (Singleton et el, 1988, p. 152). However, these weaknesses must be accepted in light of the nature of field research:

> "Field research almost always involves the non-random selection of a small number of settings and subjects. ... The delicate operation of entering the field – of locating suitable observation sites and making fruitful contacts – also necessitates non-random selection. Convenience, accessibility and happenstance by and large determine where researchers can begin to make observations, whom they will meet there, and who they will find most informative (Singleton et al., 1988, p. 305)."

In other words, a purely random sampling strategy is often not possible in field research. In choosing to conduct my field study, I determined that providing concrete

examples of the impacts of the waste trade outweighed the above methodological weaknesses. Furthermore, my selection of field sites was not purely "non-random" in that I did not select sites according to any criteria that would bias my study. Locations were determined by opportunity and availability more than any other factor. 'Fruitful contacts', in the way of traders, along with 'happenstance' influenced my site selection to a large degree.

Study Sites: Guangdong Province

Located in the southernmost part of China's mainland in close proximity to Hong Kong and Macau, Guangdong has become a major destination for plastic waste imports from developed nations, including Canada and the US.

Guangdong is China's most populous province. The province has 110 million inhabitants, including the largest migrant population in China. In addition to 79 million permanent residents, an estimated 31 million migrants from other provinces come to live in Guangdong for at least six months a year ("Guangdong faces", 2005).

Guandong leads China in key economic indicators, including Gross Domestic Product (GDP), Foreign Direct Investment (FDI), and foreign exports. It accounts for almost 12% of China's GDP and 33% of its exports and imports (International Trade Canada, 2005). The province is also home to three of China's first four special economic zones (SEZs) - Shantou, Shenzhen, and Zhuhai. These zones were established to encourage investors (foreign citizens, overseas Chinese, and companies in Hong Kong and Macau) to set up enterprises producing for the international market (Guangdong Province, 1980).

Major cities in Guangdong include the capital of Guangzhou (4.1 million), Shenzhen, (1 million), Shantou (940, 000), Foshan (430, 000), and Puning (313, 000) (City Population, n.d.).

During my research, I visited a total of 15 facilities, in Guangdong (Table 1). Two facilities – one processor and one warehouse - were located in Foshan City. One warehouse was located in Guangzhou. The remainder were located in three towns in Puning City.

	Puning			Foshan	Guangzhou	Totals
	Town A	*Town B*	*Town C*		--	
Processor	6	2	--	1	--	9
Importer	--	1	1	1	1	4
Manufacturer	2	--	--	--	--	2
Totals	**8**	**3**	**1**	**2**	**1**	**15**

Table 1. Locations of plastic recycling facilities in Guangdong, China

Determining the locations of plastics recycling facilities in Guangdong was the first step in my study. Since facility locations were determined by global transactions and market factors, this portion of my methodology also provided insight into the nature, dynamics and complexity of the plastic waste trade.

It proved much more difficult than I had anticipated, determining the specific geographic fate of imported plastics in China. The plastic waste trade is made up of a global chain of buyers and sellers, whose relationships are often difficult to trace. Furthermore, many of the actors involved in the trade were reluctant to share information, and proved evasive when questioned. The challenges I faced in penetrating this industry were not unique. A Hong Kong journalist, reporting on bottle recycling ("shredding")

plants referred to the business as "one of the territory's more cryptic industries.... (Collier, 2004)

I began my investigation into facility locations by contacting the managers of three material recovery facilities (MRF's) in Nova Scotia. All three facilities reported using the services of brokers to market their materials. The first manager said that a local company "takes it off their hands" at no cost. The second used a local waste broker to market the facility's mixed plastics. The third mentioned that a local broker was occasionally used, but more often, material was marketed by the company's in-house broker in its Ontario head office.

I contacted the head office of this last company several times to speak with the in-house broker, but never received a reply. I managed to get in touch with a local broker, who had been mentioned by two of the MRF managers. He had his own family operation in China which processed plastic bags. He said that he was not successful in obtaining a permit (required by Chinese law) for mixed plastics and could not say where Nova Scotia's mixed plastics ended up. He told me the general geographic area of his operation and said that I could email him with further questions. I contacted him twice by email, for the facility's address, but did not receive a reply. A staff member of Nova Scotia's solid waste-resources department was also unable to obtain this information.

I faced similar difficulties when I expanded my enquiries outside of Nova Scotia. Aware that California was North America's biggest exporter of plastic wastes. I contacted a broker who markets half of the state of California's wastes each year. She forwarded contact information of a few brokers onto me, but these brokers did not reply to my messages.

Once in Guangzhou, Guangdong, I met with a researcher at Greenpeace China's office. The organization had done an extensive study on the environmental and human health impacts of electronics waste recycling in Guangdong, and had indicated that they could assist me. During our meeting, the researcher mentioned that he knew areas where plastics from electronics were processed, but he had seen no evidence of packaging.

I also visited the American Chamber of Commerce, in Guangzhou for information on the trade. The Executive Director of the Chamber responded positively and said that he would send me information via email; however, he did not reply to either of two emails I sent him.

Traditional methods of finding businesses, such as searches on the internet and in China's yellow pages, turned up little. My interpreter and I visited one importer's office, just outside of Guangzhou, whose address we had found in the yellow pages. However, when we asked at the import office about factory locations, we were told that she could not give us any information on buyers.

My interpreter and I proceeded to the 'e-waste' village that Greenpeace had investigated, but after a short time walking through one of the districts, two town officials appeared, having observed me taking a photo. The officials ordered us to leave immediately. We "were not welcome" there. They followed us back to our waiting driver, shouting angrily at us to go.

On the way to Hong Kong, where I aimed to continue the 'site selection' process, I stopped in Shenzhen (located in a SEZ bordering Hong Kong) where I visited the China-Canada Business Council. The Council could not provide any information, but coincidentally had been contacted, just the day before, by a businessperson interested in

exporting. My interpreter also called the Shenzhen Plastics and Rubber Association, a contact given to me by the Canadian Consulate in Guangdong. When he asked if any of the members imported foreign scrap, he was told that this activity was not 'encouraged' by the association and that members engaging in this activity did not share this type of information with them.

In Hong Kong, I obtained lists of brokers from the Hong Kong Environmental Protection Department and the Hong Kong Trade Development Council, and contacted several of these traders by telephone, email and personal visits. The officer I spoke with at the Environmental Protection Department directed me to a list of recyclers published on its website. He said that the majority of these 'recyclers' were actually traders, and not involved in any type of processing themselves. I visited several traders, and contacted others by telephone and email. When asked where their factories were located, several importers simply replied "China" although one company mentioned factories in Indonesia and Malaysia, and another, contacted by email mentioned another province of China (Shandong). One importer said that he had a "joint-venture type relationship" with a Chinese factory. He claimed that he could not find the address and did not know the location.

Puning City was chosen as the main site for my field visits, through two avenues. In the first, the driver who had taken my interpreter and me to the town of Guiyu (where Greenpeace had conducted its investigation on electronic waste) knew of a plastic bottle importer in a nearby town in Puning. We visited one importer and one factory there, which the driver located by asking a local (who accompanied us after being paid a small fee.) We had no further chance to investigate the area at this time.

Subsequently, in Hong Kong, one particular trader whom I visited gave me the business card of his office in Puning, and mentioned that he owned two factories there. This importer was eager to buy any post-consumer material he could find, including large quantities of post-consumer bottles and film. I was unable to visit this particular trader's factories. However, my interpreter and I located other factories in the city by speaking with local taxi and rickshaw drivers, who guided us to the area.

The company I visited in Foshan was discovered from an internet search performed by a Chinese student. Other locations found on the internet were also visited in Foshan but post-consumer packaging was not found elsewhere (ie. other facilities processed domestic waste or post-industrial plastics).

Anonymity and confidentiality

I was careful in observing anonymity and confidentiality. In my field notes, I used letters of the alphabet in lieu of factory names. No names were used for participants, whether traders, factory managers, or workers.

Methodological Process: Contribution to Analysis

My methodology allowed me to understand the plastic waste trade as a global commodity chain, intricate in its operation and difficult to trace, due to the length and complexity of the commodity chain (which involved North American collectors and traders, Hong Kong brokers, Chinese importers and processors), and the evasive nature of the players involved.

Before even beginning to determine the impacts of the trade, I asked myself – what were these players trying to hide, if, indeed, this is what they were trying to do?

My visits to Hong Kong and Chinese brokers left me with some unsettling perceptions about the ethical integrity of the Hong Kong-China plastic scrap trade. For example, on my way to my first visit to an importer's office in Guangzhou, Guangdong, my interpreter had called for directions and been told that no one was there to speak with us. During our visit, he asked the woman who greeted us why she was evasive on the phone. She replied that she had thought that "we might be officials". Her comment suggested that she did not want to be 'caught' doing something wrong. When we asked where the material arrived, she told us that it came in through Hong Kong, because "Hong Kong has easier import regulations."

One importing company I visited in Hong Kong advertised itself as a "wholesaler and exporter to China of imported plastic and packaging materials." The trader I spoke with expressed special interest in importing electronics, including whole computers, despite the fact that this trade has been recently banned in China. I ran into this same trader a week later at his company's China office. He said that he had more than ten factories in the area (versus the two factories mentioned in company communications). He would not show me the factories, expressing some suspicion of my motives, as well as claiming to protect his "business secrets". I enquired whether it was a problem to send whole bottles, and noted China's strict new import regulations, which ban the import of whole plastic bottles. He claimed that such imports were not a problem. "There is a way," he said.

Other traders did express some concern over the new import regulations. One particular broker in Hong Kong said that it was "difficult to ship whole bottles" although he would accept plastic film (ie. bags). He was hesitant to import material from foreign

export companies unless they were certified under China's Quality Assurance regulations. However, he suggested that a Canadian (ie. non-certified) company could export material through a certified company, by paying them a fee. This apparent loophole appeared to defeat the purpose of the certification requirement, which was seemingly to improve accountability on the part of foreign exporters.

Data Collection: Background on Plastic waste

Statistics on plastics consumption were collected from the American Plastics Council (APC), the Environment and Plastics Industry Council (EPIC), and Industry Canada. Information on the environmental and health impacts of plastics consumption was gathered from academic articles, government agencies, and media sources. Data included information on energy and emissions from production processes, ecological impacts of waste on the landscape and marine ecosystems, incineration emissions, and associated health concerns of the above.

Information on plastics recycling concerned the environmental benefits of an idealized recycling system, the history and development of plastics recycling in Canada and the United States, and the challenges to this industry's viability, including economic, political, and technological factors. This information was obtained from industry publications, as well as books and media sources.

Data on the global magnitude of the trade was obtained from the Hong Kong Environmental Protection Department. Quantities and values of plastic waste exports from Canada were obtained by province, and country destination, from Industry Canada's online trade database.

Data Collection: Determining Impacts

A variety of data sources were used to determine the impacts resulting from the export of plastic wastes to China. The environmental and social impacts of recycling were assessed, beginning with the overseas transport of post-consumer plastics from Nova Scotia, and ending with their final treatment in recycling facilities in China.

Figures on shipping were collected from a shipping company in Halifax, and academic sources.

Data on the environmental impacts of plastic recycling in China were collected primarily through direct observation. This data included evidence of land pollution (dumping) and air pollution (emissions from recycling processes). Information on waste was also gathered from factory managers.

Data on labour conditions was collected from both direct observation of factories, and informal questioning of workers. Conditions included wages, work-hours, and working environment. Data on work tasks, worker protection, and physical work environment was obtained through observation. With the help of an interpreter, workers were asked about their wages and work hours, as well as health issues, where possible. It was possible to speak with workers at five of the processing facilities, although it was not possible to conduct full interviews. Difficulty speaking with workers was due to a number of factors. First of all, managers or supervisors were sometimes present and expressed suspicion; secondly, workers were performing tasks and we did not want to interrupt their work, for fear of getting them in trouble with their employers and/or affecting their pay.

Interviews were unstructured, and open-ended. I did not use an audio-recorder or transcription; I took interview notes during visits, where feasible, and immediately after visits, when not feasible.

Through the course of my research, I had the opportunity to speak with a number of traders, who shed light on the dynamics and 'secrecy' of the trade. Thanks to these traders, I learned how businesses operating in a global industry can take advantage of 'loopholes,' further obscuring and exacerbating environmental problems. I also quickly learned that Hong Kong was the best conduit to China for scrap plastics and other waste materials – whether legal or illegal.

Notes on Language and Communications

Mandarin is China's official national language, and is spoken and understood by the majority of Chinese people. Cantonese is the language predominantly spoken throughout Guangdong province.

Hundreds of local dialects exist in China, many of which are not understood outside of very specific locales. My main study site, Puning City is located in the Shantou region, which has been noted for its unique dialect.

Five interpreters assisted me with communications throughout my research in China. They also acted as invaluable research assistants to me. The first provided me with assistance and translation, from my arrival in Guangzhou until my departure for Shenzhen. In Shenzhen, a Chinese friend assisted me for the few days that I was there. In Foshan, another student provided communications help. Finally, in Shantou (the departure point for visits to Puning), I had the help of three people. During my first visit

back to Puning, two students helped me; one English student from Guangzhou (who spoke English, Mandarin and Cantonese) and another student who spoke the local Shanton dialect, as well as Mandarin. During my second return visit, I was accompanied by a Shantou resident whom I had met at an English language school.

I did not have the help of an interpreter in Hong Kong; however, most of the traders I contacted spoke English, or had their own translators. However, language was occasionally a problem on the phone; in a few instances, the person on the receiving end simply hung up once they heard that I was an English speaker.

Analysis

Using the above methodology I was able to collect sufficient data to identify the variety of environmental problems associated with the plastic waste trade, as well as the underlying structures which serve to generate these problems.

Creswell identifies an approach to methodology called "development of issues" (as cited in Creswell, 1998, p. 249). This approach refers to the aggregation of information into clusters of ideas and providing details that support these themes. In my case study, specific themes included welfare impacts, such as pollution, health, and labour standards; as well as theoretical concepts drawn from my literature review, such as economic efficiency, business strategy (competition), power, and distancing in the global economy. These themes will be elaborated upon in the next chapter.

Chapter 4: Case Study

The export of plastic waste for recycling will be the focus of this case study. The plastic waste trade was first investigated in Asia 1991, when a Greenpeace researcher examined the conditions of 15 recycling plants in Asia, which received plastic waste from the industrialized world. Along with unhealthy working conditions, much of the plastic imported was discovered to be unusable. The owner of an Indonesia recycling company claimed that his company had to landfill up to 40% of the imported plastic waste. In China, six containers of supposedly pure plastic waste from New York were found to contain a mix of household garbage, blood transfusion bags, and other hospital waste (Leonard, 1992). Since this time, volumes of plastic waste have only increased in countries of export, as has global trade in secondary materials (Andrady, 2003a; Beukering & Den Bergh, 2005).

This case study will test the hypothesis that the economic criteria of the global recycling market encourages the shifting of impacts of plastic waste, from more powerful to less powerful citizens. Furthermore, the case study will show how the integration of plastics recycling activities into complex global trading networks impedes accountability

I will first outline the environmental problem of plastic waste, including the nature and magnitude of its negative environmental impacts, followed by background on attempts to reduce these impacts as consistent with the economic rationale of the market. I will then show how recycling emerged as a market-based remedy to the problem of plastic wastes and subsequently developed into a globally, competitive industry. Finally,

I will demonstrate how the economics of recycling have resulted in the distancing of impacts, in this case, to Southern China.

Background

Plastics packaging will be the focus of this case study, as packaging materials are the target of household recycling programs[5]. The packaging sector constitutes the greatest end-use for plastics, and has experienced tremendous growth since the introduction of plastic packaging in the 1950's. While representing only 10% of total plastics production in 1960, this sector constituted nearly 20% of production by 1966, and almost 25% by 1969 (Meikle, 1995, p. 265). As of 2004, plastic packaging represents 34% of all plastics production in Canada, and 30% in the United States (Lopes, 2004, Market Trends, para. 2; American Plastics Council, 2005b).

Six different plastic resins are commonly used in packaging. Each resin has different properties, which determine its appropriate application. Industry resin codes are often marked on the packaging to indicate the type of material used. These codes are identified by numbers, inside of three chasing arrows[6].

The most common resins used to produce packaging are the following, with examples of each (Table 2). Numbers indicate the industry resin codes marked on the bottom of most containers.

---

[5] Note that this does not eliminate the need for an analysis of the impacts created from other sectors of the plastics industry. Plastics from the automotive and electronics industry have also attracted concern for their environmental and social impacts.

[6] These resin codes were developed by the Society of the Plastics Industry in 1988. Environmentalists have criticized the plastics industry for 'misleading' the public, since the symbols look very much like the chasing arrows (mobius) symbol indicating that a product is recyclable. This is not always the case.

Plastic Resin Code	Examples of Products
#1 polyethylene terephthalate (PET)	variety of bottles including water, soft drink, salad dressing and cosmetics; condiment jars such as peanut butter
#2 high-density polyethylene (HDPE)	variety of bottles including juice, shampoo, detergent, cosmetics, household cleaners, and medicine; retail and garbage bags
#3 polyvinyl chloride (PVC)	various clear food and non-food packaging including cooking oil and shampoo bottles
#4 low-density and linear low-density polyethylene (LDPE/LLDPE)	grocery, bread, milk and sandwich bags
#5 polypropylene (PP)	syrup bottles, yogurt containers, margarine tubs
#6 polystyrene (PS)	cutlery and plates, foam cups, meat trays, egg cartons
#7 other (made from another resin or more than one resin)	some condiment bottles, such as ketchup and mustard.

Table 2. Plastic resin codes marked on packaging

Sources: American Plastics Council (2005a); Environment and Plastics Industry Council (n.d).

Environmental Impacts: Plastic Wastes

The consumption of plastic packaging results in a number of environmental impacts. Some of these impacts are readily identifiable, while others remain quite hidden or 'invisible' to the public.

Plastic wastes create the most visible environmental problems. The environmental impacts of plastics are often perceived in terms of their contribution to litter, overflowing landfills, and pollution from incineration. However, the true effects of these wastes also include all of the environmental and socio-economic impacts associated with plastics production, as I will also discuss.

In Canada, an estimated 672, 000 tonnes of plastic waste per year are generated by households, of which 84% is made up of packaging (EPIC, 2002). A 1998 U.S. study

found that packaging waste from households is dominated by HDPE (39%) and LDPE/LLDPE (27%), followed by PET (17%). The remaining resins, polypropylene (PP) and polystyrene (PS) make up 10% and 2% of packaging waste respectively, with 'other' resins contributing the remaining 2% (as cited in Selke, 2003, p. 149).

The magnitude of impacts is reflected by the scale of the activity. Global consumption of plastics has surpassed that of all other material types, growing from 4 million tonnes in 1954 to approximately 184 million tons in 2004 (McIlwee, 2005). Between 1996 and 1999, the plastics industry experienced an annual growth rate of 4 to 5% (Andrady, 2003, p. 4). Packaging has the fastest growth rate among plastics sectors as plastics consistently replace traditional materials such as glass and metal. Plastics consumption per capita is projected to continue to grow, particularly in developing regions. Between 2001 and 2010, growth is predicted to be 32% in Japan and 46% in North America and Western Europe, while it is anticipated to be 85% in Southeast Asia, and 104% in Eastern Europe (Plastics News, 2003).

Landfills

The issue of plastic wastes has been raised with respect to the landfill crisis, since plastics do not decompose under natural conditions, and simply accumulate in landfills. The proportion of plastics in municipal solid wastes (MSW) has been increasing steadily in the past four decades, as shown in the graph below (Figure 1). In 1960, plastic waste made up only 0.5% of US municipal solid waste, compared to 12.3% in 1996 - a twenty-five-fold increase in less than four decades.

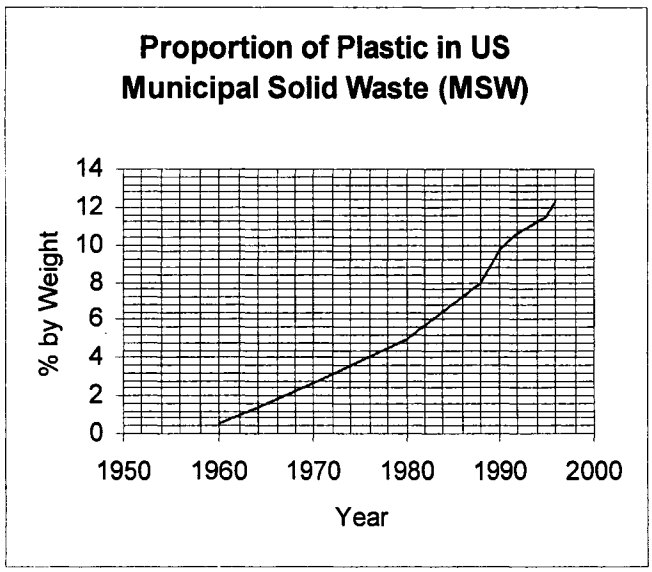

Figure 1. Proportion of plastic in US municipal solid waste stream
Adapted from OECD (2004, p. 7)

Canada's Environment and Plastics Industry Council (EPIC) (2002) estimates that plastic wastes currently represent 7 to 8 percent of residential wastes by weight, which can be used as a rough estimate of their proportion in landfills (p.6). However, these numbers do not indicate proportion by volume, due to their low density compared to materials such as metals and glass. A percentage of 7 by weight translates into an estimated 16 to 25% by volume (Meikle, 1995, p. 267). A packaging study in the United States found that 18% of discarded packaging was made up of plastics by weight; however, when estimated by volume, this figure rose to 37% (as cited in Selke, 2003, p. 14).

Plastics are claimed to be inert in landfills, meaning that they do not contribute to environmental contamination problems resulting from the disposal of solid waste (ie. leachate). However, common additives used in plastics production are not always inert.

Recent studies have shown that common plasticizers can be converted to toxic compounds by soil organisms. In one study, researchers found significant amounts of the toxic metabolites 2-ethylhexanoic acid and 2-ethylhexanol from the incomplete breakdown of plasticizers (Horn et al., 2004).

Incineration

As a method of waste management, incineration has often been criticized for polluting the air, and certain plastics in the waste stream are claimed to contribute disproportionately to this pollution. The incineration of polyvinyl chloride (PVC) has raised particular concern. PVC is thought to contribute to the formation of chlorinated dioxins in incinerators, particularly in poorly controlled incineration systems (Selke, 2003, p. 157). Polychlorinated dibenzo – *p*-dioxins (PCDD) and polychlorinated dibenzo-furans (PCDF) are two particularly toxic compounds that are associated with plastics incineration (Andrady, 2003, p. 55). Data is mixed on the specific contribution of plastics to the environmental problems caused by incineration; however, there is adequate evidence for concern.

Litter

Plastic wastes are a notorious litter item. In the narrative of one novel, the author describes "plastic bags billowing on the wind, rolling down the alleyways, gathering up dust, clotted on fences" (Ferguson, 2002, p. 285). A recent litter characterization study in Nova Scotia found that plastic items made up 34% of all litter (NSEL & NSYCC, 2004). In reality, this percentage is even greater, since composite[7] items (which often contain a layer of plastic) were represented in a separate category in this study. Composites made up a further 24% of all litter.

[7] Items made with two or more materials

The impact of plastic litter should not be dismissed as a purely aesthetic concern. Items such as plastic bags have been known to cause flooding in developing nations, by clogging drainways, and plastic items have been ingested by wildlife and farm animals; 55 kilograms of plastic were surgically removed from a cow in once incident (Dsouza, 2003).

However, the most serious impacts of litter occur in the world's oceans.

Marine pollution

The ecological problems caused by marine plastic wastes are only beginning to be understood, despite being recognized decades ago. The issue of plastics pollution in the ocean was raised in 1972, when a researcher from Woods Hole Oceanographic Institute found tiny bits of plastic in Long Island Sound, and other investigators reported high amounts of plastic litter in the Sargasso Sea (Meikle, 1995, p.290).

In the summer of 2003, in one area of the Pacific Ocean, referred to as the "eastern garbage patch" researchers calculated six pounds of plastic debris for every pound of plankton they found, including pre-production plastic pellets called "nurdles". They also discovered fragments of plastic within jelly fish and albatross chicks (Connacher, 2004). In 2004, researchers with the Canadian Wildlife Service found that one of every five northern fulmars they examined had eaten bits of plastic of various shapes and sizes ("Plastic showing up", 2004). There is evidence that ingested plastic reduces stomach capacity, causes reduced body weight in seabirds, while it can also block the intestinal tract, causing internal injury and death (Derraik, 2002). Ingestion of plastic bags and other plastic debris have been implicated in the deaths of countless sea turtles, whales, manatees, and other marine animals (Derraik, 2002).

Ingestion of plastics by marine life also poses a toxicological problem. Several studies in the 1970's found that virgin polystyrene and polyethylene resin pellets in ocean water contained polychlorinated biphenyls (PCB's), which are linked to reduced reproduction in some seabirds, caused by the thinning of egg shells. At the time, PCB's were commonly used as plasticizing additives, but it was also speculated that they could become concentrated in plastic resins from seawater. This is because both PCB's and plastics are hydrophobic (repel water). This possibility was confirmed experimentally in 2001 raising the concern that the chemicals in ingested plastics can accumulate in the fatty tissue of fish and pass up through the food chain (Gregory & Andrady, 2003, p. 388).

The problems caused by marine plastic debris are only expected to intensify as plastics consumption grows, since there are no reliable mechanisms to remove plastics from the marine environment in any practical time scale (Gregory & Andrady, 2003, p. 397.)

Environmental Impacts: Production

As noted earlier, waste is only the most visible evidence of some of the environmental problems caused by plastics. Plastic packaging produces significant impacts elsewhere in its life cycle, including depletion of non-renewable fossil fuels, and environmental damage resulting from raw resource extraction, processing, and transport.

Petroleum is the raw resource used to make plastic resins. Worldwide production of resin is estimated to account for almost 4% of total global petroleum production (as cited in Andrady, 2003, p. 38). About 2% of all fossil fuels produced in Canada each year

are incorporated into domestically manufactured plastic products (Natural Resources Canada, 2004). These seemingly small percentages add up to a significant quantity of a non-renewable resource.

A considerable amount of energy (primarily from fossil fuels) is also used for plastics production, from raw resource extraction through to the finished product. An analysis of energy use was first developed in 1990, by the Association of Plastics Manufacturers in Europe (APME) in its 'ecoprofile' data. This data shows the gross energy required to produce various polymers and plastic products (bottles and film), beginning with the extraction of crude oil and gas through to the production of monomers and polymers (powder, chips, or granules) (Boustead 2003, p. 128). In 2003, the U.S. Environmental Protection Agency (2003) released a similar life cycle inventory on HDPE, LDPE, and PET resins, based largely on APME data and adapted to North American industry practices. Some of this data, concerning energy consumption, and emissions of carbon dioxide (CO_2) and nitrogen oxides (NO_x) is shown below (Table 3). For comparative purposes, a standard passenger car with a fuel efficiency of 8.0 litres/100km could travel over 25, 000 km using the gasoline equivalent of 70, 000 megajoules (MJ) of energy.

	HDPE	**LDPE**	**PET**
Gross Energy[8] (MJ/tonne)	67,566	71,090	70,161
CO_2 (kg/tonne)	1751	2219	2151
NO_x (kg/tonne)	9.24	11.17	18.55

Table 3. Life cycle energy and emissions data for plastic resins

Adapted from U.S. EPA (2003, p. 6)

[8] Gross energy is the sum of material resource, combustion, processing and precombustion energy.

Health Impacts: Production

The APME's website describes its Ecoprofile data as "neutral, objective, quantitative information with no attempt at interpretation". However, this lack of interpretation hides much of the story with plastics production. The purely quantitative terms with which energy data is presented do not reflect social and ecological impacts. Most importantly, the relative toxicities of reported emissions are not addressed by the APME.

One life cycle study, which did take toxicities of emissions into account was a packaging study conducted by the Tellus Institute. The 1994 study estimated the emissions of more than 100 pollutants from packaging production and disposal, weighted according to their relative toxicities. They then assigned 'externality values' per tonne of each packaging type, based on pollution control costs. (Authors noted the weaknesses of using this valuation method). Comparing 19 packaging materials, consisting of various types of paper, glass, aluminium and steel, the six plastics ranked in the top seven most toxic packaging materials, with PVC as the most toxic by far. (Virgin aluminium ranked second.) (Ackerman, 1997, p. 102)

The Tellus Institute is not alone in its findings. In 1990 the World Bank rated the "synthetic resins, plastics and fibers" sector as the most toxic, in terms of emissions, among seven U.S. manufacturing sectors[9] (as cited in McGinn, 2002, p.78).

Plastics production raises significant concerns over health effects related to these toxicities. Compounds of particular concern include vinyl chloride (a confirmed

[9] Remaining sectors listed according to decreasing toxicity were pulp, paper and paperboard; industrial chemicals; radio, TV, and communications equipment; automobile, fertilizers and pesticides; and iron and steel (McGinn, 2002, p.78).

carcinogen), pthalate plasticizers, and styrene used in polystyrene (a possible carcinogen). However, even ubiquitous resins such as PET raise health concerns.

Polyvinyl chloride (PVC) has had no shortage of attention related to its health impacts, since the US Occupational Safety and Health administration (OSHA) began investigating reports of a rare liver cancer (angiosarcoma) among polyvinylchloride (PVC) workers in 1973. In 1994, laboratory tests identified the carcinogen to be vinyl chloride monomer, a gas used in the production of polyvinylchloride (Meikle, 1995, p. 269). Other toxins associated with PVC production, include the substance, 1,2-dichloroethane, used as an intermediate in the synthesis of vinyl chloride. Environment Canada considers 1,2-dichloroethane to be "probably carcinogenic to humans, as a substance for which there is believed to be some chance of adverse health effects at any level of exposure". Most of the 1,2-dichloroethane released in Canada enters the air during its production and during the production of vinyl chloride monomer.

The toxic properties of PVC continue to be studied.

Polyethylenes (which include common packaging resins, such as PET, HDPE, and LDPE/LLDPE) are the most widely used class of plastics in the world. Polyethylene production presents health concerns for workers exposed to solvents and diluents used in production, since some of these substances act as a central nervous system depressant at high enough concentrations. A chromium (IV) oxide-based catalyst used in the manufacturing process is one known toxic material. It has been acknowledged that, "a need exists for an audit and an analysis of the health impacts of these" (Andrady, 2003, p. 92). Ethylene glycol, another substance used to form PET was examined under Environment Canada's Priority Substances Assessment Program (1995), which assesses

substances to determine whether they pose a significant risk to the health of Canadians or to the environment. In rodents, the substance is known to induce slight reproductive effects and developmental toxicity, including teratogenicity (birth defects). However, "owing to the considerable limitations of the available data" on both exposure and effects in humans, Environment Canada has been unable to draw a conclusion on its toxicity. At the same time, ethylene oxide, used mainly in the manufacture of ethylene glycol as a precursor to polyethylene plastics, is concluded to be "toxic" as defined in Section 64 of the *Canadian Environmental Protection Act, 1999*. In inhalation studies, it has induced a wide range of tumours, and "a probability exists for harm at any level of exposure". Occupational exposure is a concern.

Phthalate plasticizers, used as additives in some soft plastics, are also of health concern. Environment Canada's Priority Substances Assessment Program (1995) concluded that the most common of these plasticizers, Bis(2-ethylhexyl) phthalate [also known as di(2-ethylhexyl) phthalate or DEHP], "may enter the environment in a quantity or concentration or under conditions that may constitute a danger in Canada to human health." DEHP is the most important phthalate plasticizer used in Canada (Environment Canada, 1995). Although found primarily in polyvinylchloride products such as toys and shower curtains, this phthalate can also be found in packaging, raising concerns that it may migrate into foods.

There are countless other industrial chemicals used in plastics production; however a full toxicological assessment of each lies outside of the scope of this study.

The above findings are largely indeterminate, which may in fact, give reason for greater worry. The long-term health effects of the compounds used in plastics remain

largely unknown. Many synthetic chemical compounds have never been tested for basic health impacts, such as toxicity, nor for bioaccumulative or persistent properties (McGinn, 2002, p. 80). The potential release of compounds during the use of plastics also continues to present concerns

Plastics Recycling: Background History

The development of plastics recycling serves as a good illustration of how environmental problems with plastic wastes have been subverted to and managed by market forces.

Public concerns over the environmental impacts of plastics and plastic wastes have put pressures on the plastics industry since the 1970's. After the first Earth Day in 1970, "some plastics industry insiders feared that ecological concerns might end the industry" (Meikle, 1995, p.264). The critic and environmentalist, Barry Commoner, wrote about the ecological impact of plastics, in his 1971 book, *The Closing Circle: Nature, Man, and Technology*. In addition to the solid waste implications of plastics, he noted the unknown health dangers of plasticizers and other chemicals released during plastic's use. Furthermore, after the book's publication, in 1972, researchers began to find evidence of ecological disruptions to marine ecosystems, from plastic debris in the ocean; and in 1973, medical reports began to reveal a high incidence of liver cancer among polyvinyl chloride (PVC) workers.

With concerns over overflowing landfills and toxic incinerators, terrestrial and marine litter, and (most alarming) potential human health risks, the public began to put pressures on industry to take action. However, there was no market reason for the

plastics industry to respond, so long as product manufacturers kept using plastic packaging. Consumers were not demanding packaging, but rather the product it contained. In 1970, this situation was recognized by Sydney Gross, the editor of the industry trade magazine, *Modern Plastics.* He observed that "consumers could choose only from among goods presented in the marketplace. If manufacturers used plastic – whether for versatility of design, durability, lower cost, or greater profit, then consumers had no choice but to go along. Even those who thought they despised plastic would buy it and use it, often without even recognizing it" (as cited in Meikle, 1995, p.275).

At the same time, government was beginning to intervene in the 'free market' with proposed bans and taxes on plastic packaging. In 1970, a member of the liberal city council of Madison, Wisconsin proposed a ban on non-returnable food and beverage containers and a one dollar deposit on every returnable container. A much lower deposit of fifteen cents was considered, and within a year, fifteen state legislatures were considering bills to ban or limit plastic bottles or containers (Meikle, 1995). However, the competitive interests of business overrode government efforts. In the summer of 1971, although New York City succeeded in passing a tax of two cents on every plastic bottle or container, after six months of lobbying by The Society of the Plastics Industry (SPI), the tax was declared "discriminatory and unconstitutional" (Meikle, 1995, p. 267). Similarly, in 1981, when Denmark developed a plan requiring that beer and soft drinks be sold only in returnable and recyclable bottles, they were sued by the European Commission in the European Court of Justice. Although Denmark won, they were forced to abandon the plan (Barnet & Cavanagh, 1994, p.351). Since this time, there have been

a number of legal battles fought between governments and the plastics industry, as well as with the beverage industry.

In the last half of the 1980's and early 1990's, public pressure began to mount again on the plastics industry to take environmental action, as concerns over plastic waste remained unaddressed. In place of government policies to reduce consumption, there was a demand for degradable packaging. An executive for Mobil Chemical Co, one of the largest producers of plastics packaging cited "tremendous pressure and criticism from environmentalists", beginning in the mid 1980's (Lawrence, 1991, p. 12) In the case of products like garbage bags where consumers had direct influence over demand for the product, degradability became a marketing asset for producers. In response to market demand, several bag manufacturers began to produce degradable garbage bags.

Mobil, the producers of Hefty bags, initially promoted source reduction (using less material per unit of packaging) as their solution to the solid waste problem. For quite some time, the plastics packaging industry had been lowering costs by using this strategy, which they realized also had the secondary benefit of reducing environmental impacts. However, after every one of Mobil's competitors developed degradable bags, the company launched its own degradable product.

The failure of the industry's market interests to adequately remedy environmental impacts was clear, when it was discovered that the resins that were developed for biodegradable plastic bags consisted mainly of non-biodegradable synthetic polymers and only 5-20 percent (biodegradable) starch as a filling material. The starches in these resins degraded under certain conditions, with small invisible particles of plastic remaining in the environment for years. Mobil was charged with fraud, and deceptive advertising over

environmental claims for its Hefty bags, in seven lawsuits filed by state attorneys general (Fisher, 1991). A Mobil Chemical executive admitted that the green product was the result of strategic market interests, rather than any true attempt to reduce environmental impacts: "We ... see that there are some short-term public relations gains in switching to a photodegradable plastic grocery sack or consumer trash bag, or even a biodegradable bag of each type. And it's that public relations value that has to be considered as opposed to real solutions to the problem" (Lawrence, 1991, p. 12).

Development of Plastics Recycling

Faced with failed government regulations, and poor public image following the degradability debacle, the plastics industry reconsidered recycling. The industry had not considered plastics recycling seriously until the late 1980's, since "it required sorting out dozens of different resin formulations from the general flow of garbage" (Meikle, 1995, p.267). Unlike recyclables like glass, aluminum and paper, plastics are not homogenous. They consist of several different resin types and colours, which must be sorted and processed separately. In 1988, a market research firm found that many plastics industry participants feared the recycling issue, considering it "messy, complicated, uneconomical, unnecessary, politically volatile, and an impediment to industry growth" ("Solving the plastics crisis" 1988).

However, municipal collection programs, which were growing both in scope and profile, provided an added incentive for the plastics industry to re-consider the feasibility of recycling. Competing packaging materials, such as glass and aluminum were readily accepted in these programs. The high public profile of recycling was posing as a threat to

the consumption of plastic packaging, particularly for beverage containers. In the view of the public, to toss a beverage container into a blue box versus the garbage can is a visible way to keep plastic out of the waste stream. Thus, faced with choices of packaging among the same products, environmentally conscious consumers could potentially shift to consumption of aluminum cans and glass bottles, reducing demand for plastic bottles among beverage manufacturers.

Recycling was also less costly to the industry than previous measures attempted by government, such as taxes and outright bans. Recycling has the potential to boost the environmental image of plastics, particularly with respect to packaging. Furthermore, collection programs pose as no direct cost to industry (since they are paid for by taxpayers). More importantly in garnering the support of industry, they do not threaten consumption levels.

Unfortunately, right from its start, plastics recycling in Canada and the United States has met with a number of challenges to its success in achieving the goals of its ideal - challenges that have arisen from the competitive market forces which govern any industry in the global marketplace. These challenges have provided the context within which plastic wastes are being shipped from North America (and other regions of the developed world) to China, and other Asian countries for recycling.

The Economics of Plastics Recycling: the US and Canada

In the late 1980's and early 1990's, several of the big plastics manufacturers began to invest in recycling plants, in an effort to make recycling cost-effective.

However, virtually all of these early plants closed down, due to unprofitability (Kleiner & Dutton, 1994).

In 1991, a joint venture recycling company between Dupont, the largest US chemical company, and Waste Management Inc, the largest US trash-hauling conglomerate, collapsed just two years after its start up. Waste Management Inc, which was experienced with glass, paper, and aluminum recycling, observed that it was "unexpectedly costly" to clean and sort plastics. An executive declared that "it all boils down to economics" and plastics recycling "is not economically sustainable" (Kleiner & Dutton, 1994).

Late in 1993, two more high profile plastics recycling operations closed down, claiming that they could not sell their products at a price which would let them stay in business (Kleiner & Dutton, 1994). These were not the only closures during this decade. Quantum Chemical shut down its HDPE recycling facility in 1995 and in 1996, Union Carbide closed down a plastics recycling facility it had operated since 1992 (Kirschner, 1996). Phillips Chemical Co became "the last major PE resin supplier to pull out of the recycling business", in 1998. The headline marking its demise - "Phillips exits recycling" (1998) - was in notable contrast to the optimistic headline of six years before, anticipating its future -"Recycling plant expands production potential" (1992).

The exit of the big resin companies appeared to end any conflict of interest that had occurred before, in that recycled resins actually served as direct competitors to the main business of these companies, which was supplying virgin resin made from petrochemicals. One retired executive noted that recycling had never been the core business of these companies, and that "virgin resin companies see recycling as internal

competition. They don't want to see it succeed" (as cited in Kirschner, 1996, p. 20). Kleiner and Dutton (1994) suggested that these companies "did everything possible to weaken the recycled plastic business," including lobbying against laws which would encourage the use of recycled plastic instead of virgin plastic, and even dropping prices to out-compete recycled plastic. Competition has also been blamed for lowering recycling rates for plastic scrap generated by producers, as virgin producers who had previously sold their scrap to independent reprocessors began to have it landfilled or incinerated, when they perceived reprocessors as a competitive threat (as cited in OECD, 2004, p. 21).

In the mid-1990's, it did appear that the plastics industry had lost their enthusiasm for recycling. A former Dow Chemical plastics manager argued that companies like Dow should stop promoting recycling entirely, "except for the few plastics which have obvious market value"; rather, they should put their resources into overtly convincing the public of the value of incineration" (Kleiner & Dutton, 1994).

Only the big and powerful have managed to survive, in the post-consumer plastics recycling industry. In the United States, among a total of 14 PET bottle recyclers and 30 HDPE bottle recyclers in 2003, the four largest PET companies handled almost 75% of domestically processed recycled PET, while the eight largest HDPE recyclers processed over 80% of the recycled HDPE. (American Plastics Council, 2003). This situation is evidently contrary to the ideal of localized, decentralized remanufacturers, as envisioned by recycling advocates, such as Neil Seldman (2003) of the Institute for Local Self-Reliance (p. 60). Furthermore, situations of oligopoly, according to economic theories of monopolistic and oligopolistic competition "may take the form of cutthroat competition

and economic warfare" (Kapp, 1971). This serves to further exacerbate market pressures to shift costs.

The plastics industry continues to be criticized for its lack of cooperation with the recycling industry. Recyclers complain that plastic product manufacturers disregard current recycling technologies, when designing their products. They add layers of different resin types to their products, as well as various, labels and coatings that sometimes interfere with the recycling process, requiring additional sorting, washing, higher temperatures, and caustic solutions (McIntyre, 2004). A recent OECD (2004) case study report refers to these types of characteristics as "technological externalities," which refer to the use of plastics with characteristics that make recycling more costly or difficult than would otherwise be the case (p. 13). The authors note that, without incentives to use more easily recyclable plastics in their products, manufacturers will design their products with the above characteristics, "even if the social costs of doing so outweigh the social benefits" (OECD, 2004, p. 13).

Technological "externalities" aggravate the challenges already faced by recyclers. In the U.S. "recyclers are asked to respond and solve problems at the drop of a hat because a corporate committee decides to sell their beer in a bottle with two or three different plastic resins" (Seldman, 2003, p.60).

Further challenges include technical factors unique to the industry. Whereas the high melting temperatures of aluminum, steel and glass volatise contaminants during remolding, a relatively low melting temperature for plastics[10] means that contaminants remain a concern in recycled plastics products (OECD, 2004). For this reason, the use of

[10] The melt temperature for plastics is 210F, relative to 1500 for aluminum, 2800F for glass, and 3000F for steel (OECD, 2004, p. 51).

recycled plastics is restricted in food packaging, which limits potential markets for recycled plastics in the packaging industry.

These factors work against recycling on an economic basis, so that recycled resins have difficulty competing with virgin resins in the market. In addition, although prices for recycled resins are fairly stable (as a result of fixed costs), they compete with virgin resins. Virgin resin producers are dominated by large producers, which have market power over smaller recyclers. As a result, virgin plastics producers have the market power to 'dump' their products for a period of time, if faced with a significant competitive threat from recyclers (OECD, 2004, p. 21.)

Furthermore, recycled resins are traded as global commodities "which fluctuate according to the vagaries of world markets" (EPIC, 2002, p.6). The costs of producing virgin plastic resins are highly dependant upon the price of oil, a commodity which has fluctuated greatly in the past decade. In the late 1990's and early part of the decade, the relatively low price of oil served as a disadvantage to recyclers, as they had to compete with low cost virgin resins. The price of crude oil has risen by more than five-fold since it traded at less than $11 in 1998, increasing by more than 175% since January 1, 2002, according to the *Globe and Mail* (19 March 2005, p. B15). This would appear to be good news for recyclers; however, they are now faced with a new problem – undersupply.

These companies are facing what the industry calls a "supply crisis". Capacity utilization for the American HDPE recycling industry was 68% in 2003, and approximately 59% for PET recycling (American Plastics Council, 2003). These two resin types makes up about 90% of household plastic bottles (EPIC, 2004). The Association of Postconsumer Plastic Recyclers (2004), which represents over 90% of the

post-consumer plastics bottle recyclers in North America, declared in October 2004 that "the continued critical shortage of bottles collected for recycling will soon cause the collapse of the North American plastics recycling infrastructure".

The recycling industry cites low recycling rates as one reason for this 'crisis.'

The latest figures in Canada, indicate that 36% of all plastic bottles, (both beverage and non-beverage), were recovered for recycling in 2002 (EPIC, 2004). At the same time, the number of plastic bottles collected for recycling has been growing, as consumption levels outpace recycling rates. The American Plastics Council (2003) carefully notes "... the historical trend of more pounds collected each year as the pounds of plastic bottles available for recycling continues to grow." The Association of Postconsumer Plastic Recyclers (n.d) states on its website: "for our industry to grow, we need to dramatically increase the volume of plastic that can reasonably be recycled back into a marketable product" (para. 3).

In 1994, PET was claimed to be "the one unarguable success story in plastics recycling" (Kleiner & Dutton, 1994). However, in the U.S, the recycling rate for PET bottles dropped to 19.6 % in 2003, marking the eight straight year of declines for PET bottle recycling. At the same time, PET bottle consumption grew by 6.5% in 2003. Figure 2 illustrates this trend quite clearly.

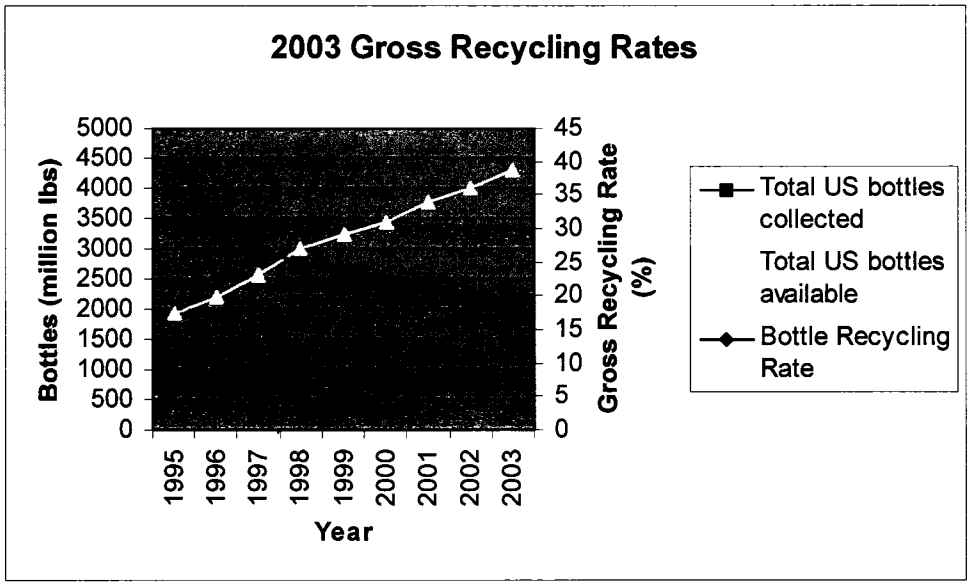

Figure 2. Trends in PET bottle consumption and recycling

Adapted from National Association for PET Container Resources (2003)

Another part of the reason for the underutilization of recycling capacity in North America is that the economics of recycling plastics drives it overseas for recycling, particularly to China. Plastics recycling and markets are heavily impacted by the export of plastics to the Pacific Rim (OECD, 2004, p. 50). According to one exporter, plastics recycling in the Western United States would not be viable without the Asian export market (P. Moore, personal communication, October 6, 2004). An estimated 70-80 percent of PET, and 40 to 50% of HDPE in California is exported, along with other resins (OECD, 2004, p. 50).

China is able to outcompete North American processors in the global market, by offering higher prices for plastic materials. The National Association for PET Container Resources (2003) notes that a "dramatic increase in pricing for baled PET... was brought on by aggressive pricing by Chinese buyers throughout the country and US reclaimers were confronted with the choice of competing or having nothing to run" (p. 5).

Material Recovery Facilities (MRF's) have benefited from the high prices of Chinese buyers. An American Plastics Council (2003) report notes that, "West Coast collectors/MRF's and even some Eastern MRF's took advantage of the high prices offered by Chinese reclaimers during the third and fourth quarters of 2003."

Furthermore, the costs of transport are favourable for traders. Freight rates have shown a steady decline since the early 1980's. The fact that it makes economic sense to transport wastes such large distances has been used by shipping analysts to emphasize just how low these rates have become. "They are so low that the export of recyclable wastes from Europe to Asia is a prospering business," note Michaelowa and Krause (2000). Furthermore, since imports from Asia into North America are much stronger than the reverse, and shipping companies do not want to send empty containers back to Asia, freight rates are particularly low for the North America to Asia journey.

It has also been argued that freight rates do not reflect environmental impacts, in fact acting as a subsidy to global trade, including the trade in recyclables. Environmental impacts caused by freight transportation include environmental health problems from emissions resulting from the combustion of fossil fuels. (For further elaboration on shipping impacts, please refer to the section subtitled "The Global Market in Waste Materials" in Chapter 2.)

While the majority of Canada's plastic wastes continue to be exported to the United States for recycling, exports to Hong Kong and China have steadily increased, while decreasing to the US (Figure 3). In 2004, 39% of Canada's plastic scrap was exported to Hong Kong (29%) and China (10.4%) (Industry Canada, 2005).

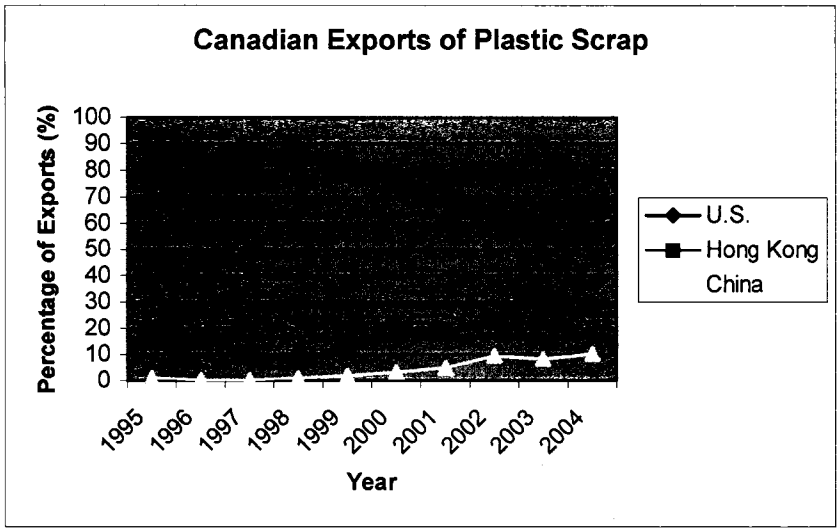

Figure 3. Trends in Canadian exports of plastics scrap

Adapted from Industry Canada (2005)

Much of the scrap plastic exported to China arrives through the port of Hong Kong, bought by Hong Kong traders, who ship the material to their counterparts in China, or directly to factories for processing. According to an officer at the Hong Kong Environmental Protection Bureau, Canada was the seventh largest exporter of plastic wastes to Hong Kong in 2003, exporting 78, 000 tonnes (and an estimated 20, 800 additional tonnes to China, based on Industry Canada's percentages). The United States was the biggest exporter to Hong Kong at 571, 000 tonnes, followed by Japan, the Netherlands, the UK, Germany, and Belgium. In total, Hong Kong imported 2, 226, 000 tonnes of scrap plastic in 2003; 1, 730, 000 tonnes (78% of this figure) were either exported or re-exported from Hong Kong to China (S. Siu, personal communication, November 28, 2004).

US exports of post-consumer PET reached a record high of 321 million pounds (145, 603 tonnes) in 2003, breaking the previous year's record by 17%. A total of 298.5

million pounds, or 93% of PET exports went to China, which represents 38% of all PET collected in the United States. (The National Association for PET Container Resources, 2003). Export figures for HDPE were 100 million pounds (45, 359 tonnes) in 2003, which represented 12% of the total bottles recovered for recycling (American Plastics Council, 2003).

Furthermore, official export figures include only shipments recorded by customs agencies. The American Plastics Council (2003) has cautioned that export quantities "may be underrepresented due to the large number of export brokers handling the material, which results *in difficulty accurately tracking the movement of the material*" (p. 6).

The field study of this case study further pursues the question: can market forces effectively address environmental problems caused by the production-consumption cycle?

Field Study: Context

Guangdong, China: Environmental and Socio-economic Context

Environmental Conditions and Standards

China faces considerable environmental problems, which are growing in intensity. In a 2000 public opinion poll, environmental degradation and protection was the number once concern cited by three thousand urban Chinese in ten cities (Economy, 2004, p. 131). Protests over polluting industries are also growing, drawing media attention. In August, 2005 farmers in eastern China staged an anti-pollution protest at a battery

factory, due to worries over high lead levels in their children's blood (Associated Press, 2005). Farmers in coastal Zhejiang province similarly rioted against chemical plants, complaining of stunted crops and health problems[11] (Johnson, 2005).

China is home to sixteen of the top twenty most polluted cities in the world (as cited in Economy, 2004, p. 72). In 2002, China's State Environmental Protection Agency (SEPA) tested the air quality of more than 300 Chinese cities, and found that almost two thirds failed to achieve WHO standards for total suspended particulates (Economy, 2004, p. 72). These particulates are implicated in respiratory and pulmonary diseases. Sulphur dioxide emissions in China are also among the highest in the world; Guangdong province produces about 690, 000 tons of sulphur dioxide annually, compared to the 80, 000 tons Hong Kong produces (Economy, 2004, p. 73).

Although China is improving its environmental standards, enforcement remains weak. The small-scale township and village enterprises (TVE's) that have been praised for contributing to China's growth have proven difficult to monitor and regulate. By 2000, TVE's were estimated to be responsible for 50% of all pollutants nationally (as cited in Economy, 2004, p. 63). Furthermore, local officials, who are widely recognized to have more clout than environmental protection authorities, often turn a blind eye to polluters, as they give priority to economic growth (Economy, 2004; Johnson, 2005).

As a result of its relatively lax environmental regulations and enforcement, China is described as "a destination of choice for the world's most environmentally damaging industries – petrochemical plants, semiconductor factories and strip mining among others (Economy, 2004, p. 63).

---

[11] For similar reports, see The Economist, *A great wall of waste* (2004).

Guangdong province is home to several of these polluting industries, particularly Hong-Kong owned enterprises. Hong Kong businesses have taken advantage of lower wages and weaker environmental laws and enforcement to site their polluting industries in Guangdong. For example, some Hong Kong businesses moved to Guangdong in the early 1990's, specifically to avoid a ban on sulphur-heavy fuel for industrial use (Economy, 2004, p. 73)

Labour Conditions

Labour Force

An overall surplus of labour and high numbers of migrant workers characterize China's labour force, resulting in a buyer's labour market. Significant migration of China's labour force from one province to another is due to large geographic disparities in economic development and employment opportunities. In 1999, there were an estimated 80 million migrant workers in China (Chan, 2001). Guangdong province, with its relatively high state of economic development, has been a major destination for workers from less developed Northern provinces.

Migrant workers provide a cheap and flexible source of labour in China; however they enjoy fewer rights than local residents. They are not entitled to the same benefits received by locals, such as social welfare, schooling, the right to own property, to bring their spouses or children with them, or even any right to residency (Chan, 2001, p. 8). Researchers into labour practices in China warn that migrants are the most susceptible to labour-rights violations (Chan, 2001).

Labour Laws

China's minimum wages are based on a system of classification. In Guangdong province, cities are grouped into seven different classes; minimum wage is highest in first class cities, such as Guangzhou, and Shenzhen (684 RMB/$100 CA per month) and lowest in seventh class cities, such as Shanwei, Meizhou, and Heyuan, (352RMB/$51 CA per month.) Puning, the main location of the factories I visited, is considered a fifth class city, with a minimum wage of 410 RMB/$60 CA per month. Foshan, the location of Site 4 is a second class city, with a minimum wage of 574 RMB/$84 CA per month.

It should be noted that China has a significantly low minimum wage, even when compared to other less developed nations in Asia (Chan, 2001, p. 11). Its minimum wage has been referred to as "the lowest possible price at which a government can sell their workers' labor in the international labour market while maintaining their workers' physical survival" (Chan, 2001, p. 12).

In addition to minimum wages, China's labour laws stipulate at least one day off a week, with a legal work week of 40 hours; workers must not work more than 32 hours of overtime per month, and must earn a pay-rate for overtime hours (Chan, 2001, p. 12).

Occupational Health

Occupational health in China is a significant concern, as the hazardous substances levels in the working environment of many industries exceed standards (Christiani, Tan, & Wang, 2002, p. 359). China's Labour Protection Act requires enterprises using poisonous or hazardous substances to report to local medical and labour inspection agencies, inform workers or risks, and take appropriate precautionary measures. In Guangdong Province, fewer than 10% of enterprises registered were found to follow the

requirements, indicating weak enforcement of regulations and laws (Christiani et al., 2002, p. 364).

Small-scale industries, which now employ more workers in China than traditional state-owned and urban collective enterprises, are a particular concern. While major occupational health problems have decreased in state-owned enterprises since the 1990's, risk of occupational diseases in small-scale industries has increased, as most lack appropriate occupational health and safety (OHS) regulations and protective or control measures (Christiani et al., 2002). A sample survey of 30 counties in 1990 showed that 83% of township and village-owned enterprises had at least one type of occupational hazard in their work environment (Christiani et al., 2002, p. 357).

Christiani et al. (2002) outline several concerns over working conditions in China's small-scale industries:

> Small-scale industries generally have weak financial and human resources and few regulations for running the enterprises. The profit motive overrides the concerns for some enterprise owners, and, combined with their low educational level, leads to a poor awareness of occupational health. Employees in these industries tend to work in adverse conditions over extended periods of time because of limited employment opportunities and lack of education. In addition, some industrial enterprises, collectives, private enterprises and join venture enterprises are especially difficult to regulate. Joint venture enterprises sometimes simply relocate occupational and environmental hazards from abroad to China, or from inland to coastal areas (p. 357).

The above descriptions of environmental and labour conditions in China (and specifically Guangdong) provide the context for the plastic waste trade.

The Impacts of Plastics Recycling in China

Problems with the plastic waste trade have been raised since Greenpeace began investigating the industry in the early 1990's. A 1996 case of alleged "waste dumping" of plastics illustrates some of the concerns with this trade, including the pointed issue of accountability. In May 1996, a shipment of plastic waste was rejected by authorities in Fuzhou, China, and sent back to Hong Kong due to contamination by household waste, such as tin cans and rotting food. A Greenpeace investigation traced the plastic bags back to a supermarket chain in Atlanta; from where they had been shipped to Los Angeles, and onto China through Hong Kong. Greenpeace (1996) placed responsibility on the supermarket chain, arguing that consumers "should be outraged to find out that the plastic waste they conscientiously return to the store for recycling is actually being shipped to third world countries". When confronted by media, officials at US supermarket chains expressed embarrassment, and said that they had been under the impression that the bags were recycled into garden furniture by a US company (Tacey, 1996). The exporter also denied any responsibility, claiming that the Hong Kong importer was aware that the waste was 'dirty'.

Despite such media reports of some of the problems with the plastic waste trade, there is a lack of formal investigation into the environmental impacts of plastics recycling in Asia, and little secondary data is available on the subject. However, even the little data that can be found indicates some cause for concern. In 1990, Hong Kong researchers investigating the toxicity of soil contaminated by untreated discharge from a factory that recycles used plastics, found nearby agricultural areas and freshwater fish ponds to be

polluted with high concentrations of copper, nickel and manganese (Wong & Chui, 1990).

More recently, environmental concerns have been raised about bottle shredding factories in Hong Kong, which have emerged in response to China's regulation banning the import of whole bottles. An estimated 60 such factories shred imported bottles from overseas, and then re-export the shards to mainland China for processing. Hong Kong's residents and environmental activists have expressed concern about noise pollution and poor water treatment practices at many of these factories. After a two-month investigation, Hong Kong's Advisory Council on the Environment reportedly issued warnings about harmful environmental practices to approximately 20 per cent of the factories (Collier, 2004).

Since China implemented its import ban, the bottle recycling industry has shifted into other Asian markets, notably in Vietnam. As of December, 2004, Vietnam had become the second largest importer of U.S. recovered PET, and by February, 2005, it had surpassed China as the number one importer of PET (Holmes, 2005, p. 18). The industry trade magazine, Plastics Recyling Update, reported that shipments to Vietnam reached 10.5 million pounds (4763 tonnes) or 35 percent of all U.S. PET exports, in the first two months of 2005 (Holmes, 2005, p. 18). Much of this material is reportedly sold to Chinese PET reclaimers who have basic sorting and grinding operations in Vietnam. The semi-processed material is then sent into China, "thus avoiding the problem of China's ban on whole-bottle deliveries" (Holmes, 2005, p. 18).

The social and environmental impacts of the plastics waste trade begin with the shipping of plastics overseas, through to its processing in China. These impacts are not

quantifiable. However, as will be seen below, they are real in terms of pollution and human health and well being.

The Environmental Impacts of Shipping Plastics to Asia

In 2003, Canada exported approximately 98, 800 tonnes of plastic wastes to China and Hong Kong (78, 000 tonnes to Hong Kong/China, and an estimated 20, 800 tonnes directly to China). This quantity of material would fill 2.8 (3500 TEU[12]) container ships, based on an average 20 tonnes of plastic scrap per 40-foot container.

At full power, an average container ship consumes approximately 65.9 metric tonnes of fuel per day (Jun et al., 2002). Container ships from Halifax, travelling through the Panama Canal, take 31 days to reach the port of Hong Kong. This length of voyage would result in approximately 2043 tonnes of fuel consumed for an average ship, resulting in the emissions described in Chapter 2.

Field Study: The Impacts of Recycling Plastics in China

Among a total of nine processing facilities which I visited in Guangdong, China, seven factories processed imported post-consumer plastic containers; and two processed imported plastic film (bags and wrap). The majority were either foreign-owned (Hong Kong) or joint-ventures, with Chinese owners working in partnership with Hong Kong traders. Facilities were concerned with the sorting and processing of imported plastic scrap into an intermediary product; generally 'flake' or pellets to be used as feedstock by plastics manufacturers in China. Six factories were located in Zhan Long, Puning; two in Meitong, Puning; and one in Foshan.

[12] TEU or "Twenty-foot Equivalent Units" is the standard unit for measuring container capacity on ships. One 40 foot container holds approximately 20 tons of plastic scrap.

Although factories varied in size, they shared the same general characteristics and work activities. Some activities (such as sorting and washing in one case) were performed outside of the building, while others were performed in an open covered area. Workers were observed sorting, washing, raking (prior to drying), operating machinery, and packaging the final product.

Many of the workers I encountered at plastics recycling factories were migrants from other provinces. Since I was unable to determine the origin of all workers, it is difficult to estimate the percentage of plastics recycling workers from outside the region. However, only one worker I spoke with was from the local area; the rest were from the provinces of Hunan, Sichuan, Hubei, Henan, and Anhui

Observed work activities were repetitive in nature. Hand sorting was performed at all factories visited, both indoors and outdoor, with workers sitting or squatting on the factory floor or ground, bending over piles of containers or plastic film. At one factory, a male worker was paid piecework to cut soiled sections from packaging, with a pair of scissors.

Washing was only observed at one facility, where workers used both cold water (in an outside basin) and hot water to clean containers, in two different stages. The washing process was not observed elsewhere. Sorting was mainly performed by women, while only men were observed operating equipment.

Processing equipment was primitive, without evidence of any pollution control equipment or protective clothing. Only men were observed operating machinery. Simple 'open' extruders were observed at two of the factories. These machines melted and extruded plastic into long 'noodles' and cut them into pellets (which served as final

products for sale to product manufacturers). In both cases, the pellets were grayish in colour, a poor quality material that could only be used in low-end products.

Environmental Impacts

In addition to air pollution resulting from emissions, as described above, visits to factories provided evidence of land and air pollution from imported plastic scrap. Piles of imported plastic material and labels were seen outside of some factories, and one manager admitted to dumping unusable material. Plastic bags and film were piled both outside and inside of the entrance to one plastic bag factory.

It is uncertain what proportion of the imported material is processed by the factories. As I was being toured through a warehouse of imported plastics in China, the Hong Kong importer pointed out a large bag of shredded material, which he could not use because "bottle shredders in Hong Kong did not bother sorting the material first". The landscape outside of this warehouse was heaped with plastic waste.

At one bottle recycling facility, the manager pointed out a bale of material from Canada and commented that the Canadian material he received was often dirty and could only be used for very low-end products. The bale contained a mix of dirty plastic packaging; much of this material was difficult to identify. Another manager of a factory in this same area also commented that the factory had experienced problems with Canadian material; it was often 'dirty' and bottles were contaminated, so that it was not suitable for making fibre. A pile of material was dumped directly across from this factory.

Furthermore, although scientific data is lacking, pollution of nearby water sources is likely. At one factory, I observed a pile of blue jugs, labelled 'corrosive,' which the

manager said would be processed. This factory used only water to clean the material and there did not appear to be any method of wastewater control, raising the concern that hazardous residues inside of containers could leach into groundwater, and/or affect workers as they handled the material. Another facility manager said that chemicals were used in the recycling process, but did not specify the chemicals used, when asked.

An analysis of water and air samples nearby these factories would aid in a better understanding of the nature and magnitude of environmental costs of plastics recycling in China.

Furthermore, the environmental costs of the plastic scrap trade are also felt in Hong Kong. One Hong Kong trader I visited said that "poor and contaminated material" was "always a problem" with shipments he received. In these situations, the company would attempt to return the material and split losses three ways, but sometimes this was not possible and the material was forced to remain in Hong Kong.

Labour Impacts

Wages and Working Hours

Conditions of the plastics recycling facilities visited in Guangdong also reflect impacts related to the health and welfare of workers. Even the limited data collected on wages and working hours reveals a violation of Chinese labour laws.

Four of the five workers my assistant and I spoke with worked seven days a week, while the remaining worker did not specify. Hours worked far-surpassed 40 hours in many cases. One female worker (Site 4) worked a basic work-week of 12 hours a day, 7 days a week, totalling 360 hours per month. This exceeds the mandated standard work-

week (approximately 170 hours) by a total of 190 hours, far past the maximum 32 hours of overtime dictated in China's labour laws. In another instance, a male worker (Site 12) worked 10 hours a day, 7 days a week, but would sometimes work up to 17 hours a day during busy times. Again, even excluding workdays over 10 hours long, this worker's monthly hours total 300.

The table below indicates actual earnings, as reported by workers, followed by monthly wages, adjusted according to a (hypothetical) legal work-week of 40 hours (Table 4). Adjusted wages are based on the assumption that pay-rate is constant, irrespective of hours worked. The figure in parenthesis shows conversion to Canadian currency, according to an exchange rate of 0.1518 Canadian dollars for 1 Chinese Yuan renmimbi (RMB).

Site	Reported wage (RMB)	Monthly wage adjusted to legal work week (RMB)	Minimum legal monthly wage (RMB)
1	15/day ($2.28) [a]	386 ($59)	410 ($62)
4 (Foshan)	500/month ($74) [b]	286 ($44)	574 ($87)
7	500/month ($74) [c]	429 ($65)	410 ($62)
12	500/month ($74) [d]	400 ($61)	410 ($62)
14	<1000/month ($148) [e]	---	410 ($62)

Table 4. Reported wages of plastics recycling workers and wages adjusted according to legal monthly working hours

a. Three female workers questioned while sorting bottles; wage based on an 8 hour workday.
b. Female worker questioned in factory while eating lunch; wage based on a 12 hour workday, 7 days a week; this worker also reported health problems.
c. Male worker reported basic wage based on an 8 hour, 7 day workweek; workers can earn as much as 800 RMB per month with overtime.
d. Male worker paid piecework (per kilogram processed); basic wage of 500 RMB per month based on a 10 hour, 7 day workweek; worker reported pay of up to 1000 RMB per month with overtime; during busy times he claimed to work as much as 17 hours a day.
e. Male worker operating extruder; length of workday and workweek unreported.

According to the adjusted wages, three out of the five workers we spoke with earned less than the legal minimum wage. The wage of the Foshan worker was

particularly low. Adjusted to the legal workweek, the monthly wage is less than half of Foshan's legal minimum wage.

Occupational Health

In addition to wages and working hours, occupational health was a concern in the plastics recycling factories I visited. Much of these concerns were related to air emissions. Workers operating processing equipment, as well as those working in the vicinity were not equipped with physical protection, such as masks, nor were there signs of proper ventilation, other than a single fan in one case. Three of the factories had an odour of melting plastics. One of these processed PVC, which is the resin type with the highest level of health concerns. In the back of this facility, I observed fumes rising above a man operating machinery. A second factory, which processed plastic bags and wrap, also contained an odour of melting plastics, rising above an open extruder. An unprotected male worker fed clear plastic wrap directly into this machine, which produced soft, gray pellets.

Similarly, at another factory, an odour rose above an open machine, which melted plastic and extruded the material into long 'noodles', which were cut into pellets. Fumes rose visibly from this machine and the factory was filled with the overpowering smell of melting plastics. The only sign of ventilation was a single fan nearby. A female, migrant worker, who claimed to be working there for a month said that she used to suffer from nausea, headaches and a burning sensation on her face, but "she got used to it". Asked why she did not wear a mask, she replied that no one else wore a mask and she did not want to "stand out".

The effects of emissions on workers' health is unknown; however, the symptoms reported by one worker indicate an uncomfortable work environment, at minimum. Both the short-term and long-term health effects of such direct, concentrated fumes require further investigation.

Distancing and Accountability

I have already discussed the difficulties I encountered in my methodology in locating factories and gathering data (Chapter 3). I attributed these difficulties to the global complexity of the plastic waste chain, where information was either unknown by agents or kept hidden. As a result, accountability for the fate of plastic material, exported by developed nations, has been confounded by the geographic scope of the commodity chain, and the number of players involved. As demonstrated by the account told earlier in this chapter about plastic bag 'dumping' in Fuzhou, it is near impossible to determine who should be held accountable in a diffuse network of consumers, sorting facilities, exporters, importers, reclaimers, and final processors involved in the trade.

One industry analyst I spoke with has been observing the dynamics of the plastics recycling industry since the late eighties (J. Powell, personal communication, October 8, 2004). He has seen the market move from Japan (now a net exporter of scrap plastic) to China and India, and claimed that markets are now moving to Southeast Asian nations such as Vietnam, Indonesia, and Thailand. The trend appears to be in response to increasing wage costs. One Hong Kong trader I visited, mentioned that his company 's operations were being expanded into Southeast Asia, in countries such as Laos. He affirmed that labour costs were lower in this country.

Furthermore, the complexity of this network thwarts regulatory attempts at controlling impacts. As Ken Conca (2002) points out, "changes in organization of production and the scope and complexity of international transactions are making traditional regulatory approaches to global environmental protection increasingly ineffective (p. 135).

China's new regulations, which are intended to improve accountability may prove no match for sophisticated traders. As one broker admitted, "there is a way" to import illegal waste into China. For one thing, it is simply too time consuming and labour intensive for authorities to carefully inspect every container ship which enters a port. The Hong Kong government inspector I spoke with during my field research admitted this difficulty. In 2004 alone, approximately 36, 000 ocean vessels arrived in the port of Hong Kong (Hong Kong Port Development Council, 2005). Secondly, even if it were possible to inspect every container, inspectors themselves introduce an additional level of agency in the chain. The success of the regulations depends, not only on the ability to track information, but on the ability and willingness of inspectors to report any illegal material that is found.

Thirdly, requiring that exporters be certified with China's Administration of Quality Supervision, Inspection & Quarantine (AQSIQ), may not succeed in improving accountability, since a non-certified scrap collector may use the services of a certified company. This requirement serves to further reduce accountability on the part of original exporters, by further lengthening the commodity chain.

Finally, even if China succeeds in enforcing its regulations, this does not necessarily reduce the impacts discussed above; it simply redistributes them. In a free

market global economy – a 'frontier economy' so to speak, there are always markets to be found, where governments are willing and able to sell their workers for less, and ignore the environmental and human health costs of the trade. In other words, where one channel is closed off, another one will open, as indicated by the shift in market to Vietnam.

The final Chapter will elaborate on the above analysis of the plastics waste trade, within the broader context of market efficiency and the shifting of impacts. The discussion will also return to the broader problem of allowing economic criteria to dominate so many of our production and consumption decisions. Finally, suggestions for remedies to these problems will be offered.

Chapter 5: Discussion

Problems With the Global Recycling Trade

The case study analysis in Chapter 4 revealed how the global recycling market, has encouraged the shifting of the plastic waste problem from consumers in industrialized nations to workers and citizens in Southern China. While consumers of plastic packaging in North America (and other industrialized nations), benefit from reduced waste disposal levels, the global plastics market is found to create new impacts in China, including land and air pollution, and occupational health problems.

Specific findings from the case study relate back to the two hypothesis posed at the start of Chapter 4. These were; that the economic criteria of the global recycling market encourages the shifting of impacts of plastic waste, from more powerful to less powerful citizens; and that the integration of plastics recycling activities into complex global trading networks impedes accountability. My examination of the global plastics recycling market found positive support for both of these hypothesis.

With respect to the first hypothesis, it is the criteria of profit that has driven waste plastic to Chinese markets for recycling. Asian traders are able to offer higher prices than western companies, due to more competitive market conditions in China. These conditions in Guangdong include a steady supply of low-cost migrant workers, poor enforcement of labour laws, and low (if any) environmental standards. In the recycling factories I visited during this study, there was indication that market conditions have encouraged the shifting of impacts from plastic waste, and created new impacts, including pollution and occupational health problems.

Furthermore, there is evidence that the impacts resulting from plastics recycling in Guangdong factories are borne by people with little income and power. Low wages, long working hours, and the presence of migrants reflected the poverty of the workers in these factories.

With respect to the second hypothesis, the case study showed how the integration of plastics recycling activities into complex global trading networks resulted in difficulty in tracing impacts and determining accountability. My field research revealed the near impossibility of tracking materials from exporters to individual factories, and the difficulty in locating factories, even with the help of native Chinese speakers. This problem is compounded as market conditions change and markets are moved to new regions, as is the case with the shift of bottle processing activities to Vietnam. Material processed today in a hypothetical high-tech factory in Beijing may be processed tomorrow in a small factory in a Vietnamese Indian village that is ill-equipped to safely manage potentially hazardous materials. While not all plastic waste exports are necessarily processed under the conditions found in this study, there is little guarantee of this.

The above findings have implications that go beyond the specific case of plastics recycling. First of all, while other global recycling markets (ie. metals and paper) may not result in the same specific impacts as those found for plastics in this case study, past investigations have revealed similar environmental and health problems with other recycling markets, such as those for batteries and electronics. Secondly, the environmental impacts of shipping are a problem that is inherent to the trade of any waste material. Finally, the complexity and geographic scope of global trade relationships

means that exporters can never be fully assured how responsibly their material is managed.

Remedies to the Global Waste Trade

On the surface, it might seem that trade restrictions could solve the problem of waste exports. However, as discussed in Chapter 4, import bans face practical difficulties resulting from sophisticated trade networks and corruption. Secondly, eliminating one market opportunity does not solve the problem, since new markets will emerge elsewhere as is happening with the Vietnamese market for whole bottles. Export bans are a better option, since in this case the onus is on the country of export which is more capable of effective enforcement. Again though, while such a ban might eliminate negative impacts in developing nations, it would have to be only part of the solution, since many problems with recycling run deeper than the global waste trade.

The Deeper Problem with Recycling

Recycling in itself is not an inherently bad way to manage waste, and there is nothing to suggest that the concept of re-processing waste materials into new and useful products is somehow misguided. For centuries, people have used scrap materials for re-use in the production of new goods, reducing waste in the process. However, while recycling can be an effective strategy in environmental terms, it is not the only answer to environmental problems created by consumption, and certainly not enough to address the problems we are faced with today.

For recycling to succeed environmentally, at its basic minimum, it must curtail the overall consumption of virgin resources. However, this does not appear to be the case, at least for plastics, for the simple reason that recycling growth rates are not keeping up with overall consumption rates, as shown in Chapter 4.

The fundamental problem with recycling is that it does not address the heart of the waste problem which concerns the market criteria which encourage unsustainable production and consumption practices.

The Market as a Policy Instrument

This problem concerns the economic rationale of the global market. A market structured upon economic criteria is not capable of addressing environmental goals. As outlined in Chapter 2, environmental criteria are absent from decision-making at the very beginning of the waste problem – production. Production decisions, which lack such criteria result in environmentally damaging product design, distancing of production activities, and associated impacts throughout the entire production-consumption cycle.

When cost is the only criteria, production becomes cheaper abroad, and it becomes efficient to import goods from the opposite side of the earth. The majority of these goods could easily be produced in the region of import. It is not a question of the exporter having 'natural' advantages (based on natural resources or geography) in producing the good in question, but a question of economic efficiency – usually based on cheaper conditions of production.

This situation is occurring because we are mixing up our perception of social well-being and progress with concepts of economic efficiency, so that efficiency has

reached the status of a social goal. As discussed in Chapter 1, as individual firm seeks efficiency by lowering its costs, this can result in a shifting of 'costs' (impacts) towards 'less well off' members of society.

Furthermore, economic efficiency can result in environmental impacts, since it does not imply *environmental* efficiency. As discussed elsewhere in this paper, many environmental impacts are not accounted for in economic transactions, meaning that economic efficiency can actually be detrimental to the environment. An example of efficiency's disregard for the environment is found in one author's musings about some Japanese toothpicks he finds in a Minnesota restaurant: "Japan has little wood and no oil; nevertheless, it has become efficient enough in our global economy to bring little pieces of wood and barrels of oil to Japan, wrap the one in the other and send the manufactured product to Minnesota" (Morris, 1996, p. 222). Herman Daly similarly notes the misconceptions of efficiency in trade, observing that more than half of all international trade involves the simultaneous import and export of essentially the same good. Giving the example of Americans importing Danish sugar cookies as Danes import American sugar cookies, Daly (1996) remarks that "exchanging recipes would surely be more efficient" (p. 231).

The bottom line is that a production-consumption system based on the concept of economic efficiency is neither socially nor environmentally progressive.

Remedies to the Waste Problem

Environmental problems must be addressed at the level of production and consumption. Stronger environmental criteria must be developed for products so that

they are designed for re-use and durability, rather than disposal. This would require strong government regulation on product performance, and end-of-life management. Products currently on the market that do not meet the new criteria, could be phased-out and eventually banned, or at minimum be subject to fees or taxes to reduce consumption to an environmentally acceptable level. Environmentalists might argue that this last suggestion – the use of economic instruments – is more consistent with neoclassical strategies. The important distinction is in how such instruments are used. In a re-structured market, economic instruments could be used as tools to achieve goals. However – and this is the distinction – the goals would be determined by public policy, not by the market. If the economic instrument proved ineffective in reaching a desired environmental goal, a more effective tool would be implemented. In other words, economics would be the means of reaching preferred social outcomes, rather than the goal of the market.

One concept that is quickly gaining popularity in OECD nations as a remedy to the waste problem is 'Extended Producer Responsibility' or EPR. When it was first coined in 1995, EPR was defined as "a policy principle to promote total lifecycle environmental improvements of product systems by extending responsibilities of the manufacture of the product to various parts of the product's life cycle and especially to the take-back, recovery and final disposal of the product". EPR programs have since been developed on a provincial basis in Canada, as well as in other developed nations. The theory is that when producers are involved in the end-of-life management of their products, they have incentives to consider the consequences of product design on re-use and recycling.

The potential for EPR is significant. Unfortunately, the desired outcomes of EPR – true industry responsibility and design for the environmental have yet to be achieved. Costs are being passed directly to consumers, rather than 'internalized' by producers as a business cost, and when products reach their end of life, they are physically managed by a separate waste management system – not by the producer. The result in these 'watered down' programs is that producers are given no real responsibility or incentive to design their products for re-use or recycling.

On a more positive note, the current shortcomings of EPR relate to its current application, not to the concept. With concepts of economic efficiency and global competitiveness dominating current public policy, true producer responsibility is perceived to threaten the competitiveness of producers with an uneven playing field, and mandatory take-back of products threatens the efficiency of a producer's global supply chain. Should 'true' EPR policies be implemented, these policies could prove to be a promising way to reduce waste and pollution at source.

At the same time, successfully addressing the waste issue does not solve other forms of shifting impacts. As noted in Chapter 1, the global shifting of impacts also results from the import of pollution-intensive resources and manufactured goods from developing nations. When production itself occurs in locations of cheap labour and low environmental standards, with goods consumed in the more affluent nations, this poses a problem that cannot be solved by policies of Extended Producer Responsibility.

Alternative Policy Instruments

It has been commented that the purpose of the economy should be to serve people, not the other way around. It follows that we must restructure our decision-making to reflect the priority of people over economics. First, we need to replace the misguided concept of economic efficiency with new criteria of progress, which would more adequately reflect social and environmental well-being. The second, which could go hand in hand with the first, is to shorten the distance of our commodity chains – in other words, move the production of goods closer to where they are consumed.

The need for new indicators of progress is gaining more widespread acceptance, with governments now recognizing the need for new measurements of progress. In 2000, Canada's spring budget included the "Environment and Sustainable Development Indicators" (ESDI) Initiative, under the umbrella of the National Roundtable on the Environment and Economy (2003). Canada's Minister of Finance noted that "we must come to grips with the fact that the current means of measuring progress are inadequate" (NREE, 2003, p. 1). New national indicators would certainly be helpful in changing cultural perceptions that economic growth is not a true reflection of quality of life. At the same time, on a more fundamental level that would challenge current market thinking, these indicators would need to be reflected in daily decisions, both by government and businesses concerning production and consumption. It follows that decisions would need to be made increasingly outside of the market structure, replacing decisions made by the criteria of economic efficiency with decisions made by broader social criteria. This would require a shifting of decision-making from the private to public sector, which could result in the creation of new institutions and progressive regulations which give

priority to social and environmental considerations. Effective inter-regional and international cooperation would also be required to ensure consistency and close loopholes.

The second change which would need to be made to our production-consumption system is a reduction in the length of the commodity chain. This could be expected to occur as a natural outcome of the new decision-making criteria already discussed. As it became evident that the environmental repercussions of shipping toothpicks and butter cookies all over the world outweighed the economic benefits, it would become more 'efficient' to produce such items closer to home. The concept of efficiency would take on a new meaning in environmental terms, referring to the amount of natural resources used in making products and the lack of waste produced in converting raw material into a consumer or industrial product (Morris, 1996, p. 224).

Government could use economic instruments as a tool in this regard as well, for example imposing taxes on goods, according to geographic distance from their source. (One possibility is a substantial freight tax.) Mandated product re-use would also be an effective way to regulate the distance a commodity could travel. An example is the refillable glass bottle, which requires local bottling and distribution.

More localized economic networks would also remedy the repercussions of distancing, making both producers and consumers more accountable for their impacts. As explained by Patricia Perkins (1998), the advantages of localized economic integration (or 'bioregionalism') are that people can know, understand and control the impact of their actions, relative to complex, global networks where it is "almost

impossible for people to recognize when their consumption is exceeding the bounds which are ecologically sustainable" (p. 48).

This is not to say that all forms of international trade would be abandoned, only that the criteria on which trade is based would change. Trade would need to be based on a different form of comparative advantage which was not based only on relative costs, and cheap freight rates. Examples of such an advantage could include the abundance of a particular resource (evidently "sustainably harvested"), or possession of a beneficial technology. Accountability would also need to be ensured by keeping the length and complexity (number of agents) of the supply chain at a minimum. Fair trade systems currently in place for coffee and other commodities serve as good models. In these systems, primary producers deal directly with buyers, who prioritize fair economic terms, social welfare and environmental protection, rather than price.

New indicators of progress and localization versus globalization of economies might seem like far-fetched ideals, but this is only because the concept goes against the grain of dominant public discourse. We are so used to hearing about the ideals of efficiency, competitiveness and growth that we have come to accept them as 'good' and 'right' without questioning their implications on the welfare of ourselves and others.

Movement away from the present goals of economic efficiency, export growth and competitiveness towards goals of domestic economic integration with stronger local economies, better jobs and a cleaner environment would evidently require a substantial change in public discourse in order to change cultural perceptions and behaviour.

The media, government and advertisers would have to move away from the economic language that has permeated modern life. This could accomplish much in

changing public perceptions of well-being, and how people are willing to behave to achieve social goals. At the same time, when criteria related to environmental protection and social welfare are incorporated into production decisions, people would need to be prepared to pay prices that reflect the actual worth of the inputs required. These 'inputs' would need to be understood as tangible people and things that actually mean something. These are the natural resources we consume almost unthinkably everyday, and the time and labour of the people who contribute to their production. These new social ideals are not radical in their logic, but probably quite consistent with the average citizen's aspirations.

References

Ackerman, F. (1997). *Why do we recycle? Markets, values, and public policy.* Washington: Island Press.

Ackerman, F. & Heinzerling, L. (2004). *Priceless: on knowing the price of everything and the value of nothing.* New York: The New Press.

American Plastics Council. (2003). *APC 2003 National post-consumer plastics recycling report.* Retrieved: February 12, 2005, from http://www.plasticsresource.com/s_plasticsresource/docs/1700/1646.pdf

American Plastics Council. (2005a). *Resin identification codes. Plastic recycling codes.* Retrieved: March 8, 2005, from http://americanplasticscouncil.org/s_apc/sec.asp?TRACKID=&CID=313&DID=931

American Plastics Council. (2005b). *Industry Statistics* [Major market distribution pie chart]. Retrieved: June 4, 2005, from http://www.americanplasticscouncil.org/s_apc/sec.asp?CID=296&DID=895

Andrady, A. (2003a). An environmental primer. In A. L. Andrady. (Ed.), *Plastics and the environment.* (pp. 3-76). Hoboken, New Jersey: John Wiley & Sons.

Andrady, A. (2003b). Common plastics materials. In A. L. Andrady. (Ed.), *Plastics and the environment.* (pp.77-122). Hoboken, New Jersey: John Wiley & Sons.

Associated Press. (2005, August 25). Government in east China steps in after pollution protest by farmers. *Environmental News Network.* Retrieved: September 6, 2005, from http://enn.com/today_PF.html?id=8614

Association of Postconsumer Plastic Recyclers (APR). (2004, October 21). *Plastics recycling crisis deepens.* [Press release]. Retrieved: January 27, 2005, from http://www.plasticsrecycling.org/#

Association of Postconsumer Plastic Recyclers (APR). (n.d.) *Position regarding deposit legislation.* Retrieved: January 27, 2005, from http://www.plasticsrecycling.org/about-position.asp

Bandow, D. (1997, August 27). *Our widespread faith in recycling is misplaced.* Retrieved: September 2, 2005, from http://www.cato.org/dailys/8-27-97.html

Banuri, T. (1993). The landscape of diplomatic conflicts. In W. Sachs (Ed.), *Global ecology: a new arena of political conflict.* (pp. 49-67). Halifax: Fernwood Publications.

Barlaz, M.A., Kaplan, P.O., Ranjithan, S.R., & Rynk, R. (2003). Evaluating environmental impacts of solid waste management alternatives. *Biocycle, 44*(10), 52-57. Retrieved: January 28, 2005, from EBSCO database.

Barnet, R. J. & Cavanagh, J. (1994). *Global dreams: imperial corporations and the new world order.* New York: Simon & Schuster.

Basel Action Network and Silicon Valley Toxics Coalition (2002). *Exporting harm: the high-tech trashing of Asia.* Retrieved: June 6, 2004, from http://www.ban.org/E-waste/technotrashfinalcomp.pdf

Becker, E. & Jahn, T. (1998). Growth or development? In R. Keil, D. Bell, P. Penz, & L. Fawcett (Eds.), *Political ecology. Global and local.* (pp. 68-83). London: Routledge.

Beukering, van. P.J.H. & Den Bergh, van. J.C.J.M. (2005). Modelling and analysis of international recycling between developed and developing countries. *Resources, Conservation and Recycling* [In Press]. Retrieved: August 20, 2005, from Science Direct database.

Bhagwati, J. (1993). The case for free trade. *Scientific American, 269*(5), 42-49.

Boustead, I. (2003). Polymers and energy. In A. L. Andrady (Ed.), *Plastics and the environment.* (pp.123-135). Hoboken, New Jersey: John Wiley & Sons.

Boyce, J.K. (2002). *The political economy of the environment.* Northampton: Edward Elgar Publishing Limited.

Brigden, K., Labunska, I., Santillo, D. & Allsopp, M. (2005). *Recycling of electronic wastes in China and India: workplace and environmental contamination.* Retrieved: August 21, from http://www.e-takeback.org/press_open/greenpeace.pdf

Center for Investigative Reporting (CIR) & Moyers, B. (1990). *Global dumping ground: The international traffic in hazardous waste.* Washington: Seven Locks Press.

Chan, A. (2001). *China's workers under assault: the exploitation of labor in a globalizing economy.* Armonk, New York: M.E. Sharpe Inc.

Chapman, D., Agras, J., & Suri, V. (1999). Industrial and resource location, trade, and pollution. In M.H.I. Dore & T.D. Mount (Eds.), *Global environmental economics: equity and the limits to markets.* (pp. 267-284). Malden, MA: Blackwell.

Christiani, D.C., Tan, X., & Wong, X. (2002, July-September). Occupational health in China. *Occupational medicine: state of the art reviews, 17*(3), 355-370.

City Population. (n.d.). *Guangdong*. Retrieved: July 21, 2005, from http://www.citypopulation.de/China-Guangdong.html#i5517

Clapp, J. (2001). *Toxic exports: the transfer of hazardous wastes from rich to poor countries.* New York: Cornell University Press.

Collier, A. (2004, October 13). Bottle recyclers highlight NT's lack of land planning. *The Standard.* Retrieved: November 8, 2005, from http://www.thestandard.com.hk/txtarticle_v.cfm?articleid=51408

Commoner, B. (1971). *The closing circle: nature, man and technology.* Westminster, MD: Random House Inc.

Conca, K. (2002). Consumption and environment in a global economy. In T. Princen, M.Maniates, & K.Conca, (Eds.), *Confronting consumption* (pp. 133-153). Cambridge, MA: The MIT Press.

Connacher, I. (2004, January 17). Awash in a sea of synthetics. *The Globe and Mail.* p. A17.

Creswell, J.W. (1998). *Qualitative inquiry and research design: choosing among five traditions.* Thousand Oaks, California: Sage Publications.

Daly, H. (1993). The perils of free trade. *Scientific American, 269*(5), 50-57.

Daly, H. (1996). Free trade: the perils of deregulation. In J. Mander and E.Goldsmith (Eds.), *The case against the global economy: and for a turn toward the local* (pp. 229-238). San Francisco: Sierra Club Books.

Derraik, J.G.B. (2002). The pollution of the marine environment by plastic debris: a review. *Marine Pollution Bulletin, 44,* 842-852.

Doren, van. P. (1999, January 21). Time to trash government intervention in garbage service. *Policy Analysis, 331.* Retrieved: September 2, 2005, from http://www.cato.org/pubs/pas/pa-331es.html

Downing, P.B. (1984). *Environmental economics and policy.* Toronto: Little Brown & Company.

Durning, A.T. (1992). *How much is enough? The consumer society and the future of the earth.* New York: Norton.

Dsouza, L. (2003, June 11). 55 kg plastic removed from cow's stomach. *Mid-Day Multimedia Ltd.* Retrieved: April 2, 2005, from http://web.midday.com/news/city/2003/june/55529.htm

Economy, E. (2004). *The river runs black: the environmental challenge to China's future*. London: Cornell University Press.

Environment Canada (1995). *Priority substances assessment program*. Retrieved: April 6, 2005, from http://www.ec.gc.ca/substances/ese/eng/psap/psap_1.cfm

Environment Canada. (1999). Strategic issues in waste prevention: an OECD view. *Ecocycle, 7*, Fall/Winter. Retrieved: August 14, 2005, from www.ec.gc.ca/ecocycle/issue7/en/p4.cfm

Environment Canada (2002). *Fact sheet 8 – Waste: 1990-1999*. Retrieved: August 18, 2005, from http://www.ec.gc.ca/pdb/ghg/factsheet8_e.cfm

Environment and Plastics Industry Council (EPIC). (2002). *Directions for recycling plastics and managing plastics residues*. Retrieved: March 11, 2005, from http://www.cpia.ca/files/files/files_Directions-Recycling_Plastics.pdf

Environment and Plastics Industry Council (EPIC). (2004). *An overview of plastic bottle recycling in Canada*. Retrieved: July 20, 2005, from http://www.cpia.ca/files/files/files_plastic_bottle_recovery.pdf

Environment and Plastics Industry Council (EPIC). (n.d). *SPI plastic container coding system*. Retrieved: March 8, 2005, from http://www.cpia.ca/files/files/files_resin_code_sheet.pdf

Ferguson, W. (2002). *Happiness*. Toronto: Penguin.

Field, B. & Olewiler, N. (2002). *Environmental economics*. (2nd ed.) Toronto: McGraw-Hill Ryerson.

Fisher, C. (1991, April 1) Mobil avoids Hefty green claim. *Advertising Age, 62* (14), 4.

Gandy, M. (1994). *Recycling and the politics of urban waste*. London: Earthscan.

Gardner, G., Assadourian, E. & Sarin, R. (2004). The state of consumption today. In B. Halweil (Ed.), *State of the world 2004*. (pp. 3-23). New York: W.W. Norton & Company.

Gould, K.A., Schnaiberg, A., & Weinberg, A.S. (1996). *Local environmental struggles: citizen activism in the treadmill of production*. Cambridge: Cambridge University Press.

GPI Atlantic. *The Nova Scotia GPI solid waste-resource accounts*. Retrieved: July 2004, from http://www.gpiatlantic.org/pdf/solidwaste/solidwaste.pdf

A great wall of waste. (2004, August 21). *The Economist, 372,* 55-57.

Greenpeace. (1996, July 17). *Atlanta welcomes the world ... Winn Dixie dumps on it.* [Press release]. Retrieved: February 22, 2005, from http://www.things.org/~jym/greenpeace/exposes-plastic-waste-trade.html

Gregory, M.R. & Andrady, A. (2003). Plastics in the marine environment. In A. L. Andrady. (Ed.), *Plastics and the environment.* (pp.379-402). Hoboken, New Jersey: John Wiley & Sons.

Guangdong faces population pressure. (2005, February 16). *Xihua News Online.* Retrieved: June 16, 2005, from http://news.xinhuanet.com/english/2005-02/16/content_2582910.htm

Guangdong Province. (1980, August 26). *Regulations on special economic zones in Guangdong province.* Retrieved: June 16, 2005, from http://www.novexcn.com/guangdong_regs_on_sez.html

Holmes, K. (2005, June). Pouring through the numbers. Factors fueling the hot plastics market. *Resource Recycling,* 17-20.

Hong Kong Port Development Council (2005). *Summary statistics on port traffic of Hong Kong.* Retrieved: March 15, 2005, from http://www.pdc.gov.hk/eng/statistics/docs/Jan2005.pdf

Horn, O., Nalli, S., Cooper, D, & Nicell, J. (2004). Plasticizer metabolites in the environment. *Water Research, 38*(17), 3693-3698. Retrieved: April 17, 2005, from ScienceDirect database.

Industry Canada. (2005). *Trade data online [HS Code 3915].* Retrieved: February 18, from http://strategis.ic.gc.ca/sc_mrkti/tdst/engdoc/tr_homep.html

International Trade Canada [Trade Commissioner Service]. (2005). *Fact Sheet – Guangdong Province – China.* Retrieved: June 16, 2005, from http://www.infoexport.gc.ca/ie-en/DisplayDocument.jsp?did=42412

Jacobs, M. (1997). The limits to neoclassicism: towards an institutional environmental economics. In M. Redclift & G. Woodgate (Eds.), *The international handbook of environmental sociology.* (pp. 67-91). Northampton: Edward Elgar.

Johnson, T. (2005, July 25). In China's dash to develop, environment suffers severely. Knight Ridder Washington Bureau. *Environmental News Network.* Retrieved: August 1, 2005, from http://enn.com/today_PF.html?id=8322

Jones, C.T. (2005, April 23). The plastics puzzle. *The Globe and Mail.* p. M2.

Jun, P., Gillenwater, M. & Barbour, W. (2002). CO_2, CH_4, and N_2O emissions from transportation-water-borne-navigation [Background paper]. In Intergovernmental Panel on Climate Change (Ed.), *Good practice guidance and uncertainty management in national greenhouse gas inventories.* (pp. 71-92.) Hayama, Japan: Institute for Global Environmental Strategies. Retrieved: January 22, from http://www.ipcc-nggip.iges.or.jp/public/gp/bgp/2_4_Water-borne_Navigation.pdf

Kapp, K.W. (1971). *The social costs of private enterprise.* New York: Schocken Books.

Kirschner, E.M. (1996, November 4). Recycling's rough adolescence. *Chemical & Engineering News, 74*(45), 19-22.

Kleiner, A. & Dutton, J. (1994). Time to dump plastics recycling? *Garbage, 6*(1), 44-51. Retrieved: February 8, 2005, from EBSCO database.

Lawrence, J. (1991). Mobil. *Advertising Age, 62* (5), 12-13.

Leonard, A. (1992, September 4). *Where do all our 'recycled' plastics go?* Retrieved: November 5, 2003, from http://www.fish.com/~jym/greenpeace/where-recycled-plastics-go.html

Lindblom, C.E. (2001). *The market system: what it is, how it works, and what to make of it.* New Haven: Yale University Press.

Lofdahl, C.L. (2002). *Environmental impacts of globalization and trade.* Cambridge, MA: MIT Press.

Lopes, M. (2004, February 23). *Stat-USA market research reports.* Retrieved: June 4, 2004, from http://strategis.ic.gc.ca/epic/internet/inimr-ri.nsf/en/gr116973e.html

MacIntyre, K. (2004, March 5). Plastics: meeting the challenges of the supply and demand cycle. [Session 10, Lunch Address, Slides 9-11] *Canada's 3rd National Workshop on Extended Producer Responsibility.* Retrieved: July 2004, from http://www.gov.ns.ca/enla/waste/epr/docs/2004-March-5/KentMacIntyre.pdf.

MacNeill, J., Winsemius, P. & Yakushiji, T. (1991). *Beyond interdependence. The meshing of the world's economy and the earth's ecology.* New York: Oxford University Press.

Martinez-Alier, J. (2002). *The environmentalism of the poor: a study of ecological conflicts and valuation.* Cheltenham, UK: Edward Elgar Publishing.

McGinn, A.P. (2002). Reducing our toxic burden. In Worldwatch Institute (Ed.) *State of the world 2002.* (pp. 75-99). New York: W.W. Norton & Company.

McIlwee, I. (2005). *Plastic planet.* [Appeared in October, 2005 edition of LME Ringsider magazine.] Retrieved: August 18, 2004, from http://www.lme.co.uk/downloads/Plastic_planet_vs_for_web__Oct_04_.pdf

Meikle, J. (1995). *American plastic: a cultural history.* New Brunswick, NJ: Rutgers University Press.

Michaelowa, A. & Krause, K. (2000). International maritime transport and climate policy. *Intereconomics, 35*(3), 127-137. Retrieved: January 30, 2005, from ABI/Inform database.

Millennium Ecosystem Assessment (2005). *Ecosystems and human well-being: synthesis.* Island Press: Washington, DC. Retrieved: September 16, 2005, from http://pubs.wri.org/pubs_pdf.cfm?PubID=4085

Morris, D. (1996). Free trade: the great destroyer. In J. Mander and E.Goldsmith (Eds.), *The case against the global economy: and for a turn toward the local* (pp. 218-228). San Francisco: Sierra Club Books.

Muradian, R. & Martinez-Alier, J. (2001). Trade and the environment: from a 'southern' perspective. *Ecological Economics, 36,* 281-297. Retrieved: July 6, 2005, from Elsevier database.

National Association for PET Container Resources (NAPCOR). (2003). *2003 report on post consumer PET container recycling activity.* Retrieved: March 2, 2005, from www.napcor.com

National Recycling Coalition Policy Workgroup (1999). *Leveling the playing field for recycling. A policy report on virgin material subsidies from the National Recycling Coalition.* Retrieved: August 15, 2005 from http://www.nrc-recycle.org/member/advocacy/policypositions/subsidiesrpt.pdf

National Round Table on the Environment & Economy (NRTEE). (2003). *Environment and sustainable development indicators for Canada.* Ottawa: Renouf Publishing.

Natural Resources Canada. (2004, August). An overview of plastic recycling options. *R-NET Recycling Technology Newsletter,* 8(1), 4-7. Retrieved: September 14, 2004, from http://www.nrcan.gc.ca/mms/canmet-mtb/mmsl-lmsm/rnet/archives/spring2004-e.pdf

Nova Scotia Environment and Labour (NSEL) & Nova Scotia Youth Conservation Corps (NSYCC). (2004). *A characterization of Nova Scotian litter. 2004 litter survey.* Unpublished manuscript.

Organization for Economic Co-operation & Development (OECD). Environment Policy Committee. Working Party on National Environmental Policy. (2004).

Improving markets for secondary materials: case study report on plastics. ENV/EPOC/WPNEP(2004)3. Available from OLISnet [Official Use].

Oxford dictionary of current English. (3rd ed.). (2001). Oxford: Oxford University Press.

Pearce, D. (1977). The economics of pollution. In N. Holmes (Ed.), *Environment and the industrial society.* (pp. 165-190). Boulder: Westview Press.

Pearce, D. & Turner, R.K. (1990). *Economics of natural resources and the environment.* Hertfordshire: Harvester Wheatsheaf.

Perkins, P.E. (1998). Sustainable trade: theoretical approaches. In R. Keil, D. Bell, P. Penz, & L. Fawcett (Eds.), *Political ecology. Global and local.* (pp. 46-67). London: Routledge.

Phillips exits recycling. (1998, November). *Plastics Technology, 44*(12). Retrieved: February 7, 2005, from EBSCO database.

Pigou, A.C. (1932). *The economics of welfare.* (4th ed.). London: Macmillan & Co.

Pingkuan, D. (2005, October). *Diesel particulate matter exposure assessment study for the ports of Los Angeles and Long Beach [Draft].* California Environmental Protection Agency. Air Resources Board. Retrieved: October 5, from http://www.arb.ca.gov/msprog/offroad/marinevess/documents/100305draftexposrep.pdf

Plastic showing up in guts of northern birds. (2004, November 4). *CBC Health and Science News.* Retrieved: November 5, 2004 from http://www.cbc.ca/story/science/national/2004/11/04/plastic_seabirds041104.html

Plastics News (2003). *Per capita plastics consumption.* Retrieved: February 5, 2005 from http://www.plasticsnews.com/subscriber/fyi.html?id=1065015902

Porter, G., Brown, J.W. & Chasek, P.S. (2000). *Global environmental politics.* (3rd ed). Boulder: Westview Press.

Princen, T. (2002a). Consumption and its externalities: where economy meets ecology. In T. Princen, M.Maniates, & K.Conca, (Eds.), *Confronting Consumption* (pp. 23-42). Cambridge, MA: The MIT Press.

Princen, T. (2002b). Distancing: Consumption and the severing of feedback. In T. Princen, M.Maniates, & K.Conca, (Eds.), *Confronting Consumption* (pp. 103-131). Cambridge, MA: The MIT Press.

Princen, T., Maniates, M., & Conca, K. (2002). Confronting Consumption. In T. Princen, M.Maniates, & K.Conca, (Eds.), *Confronting Consumption* (pp. 1-20). Cambridge, MA: The MIT Press.

Recycling plant expands production potential. (1992, June 22). *Design News, 48* (12). Retrieved: February 7, 2005, from EBSCO.

Ruff, L.E. (1970). The economic common sense of pollution. In R. Dorfman & N.S. Dorfman. (Eds.), *Economics of the environment. Selected readings.* (3rd ed.). (pp. 20-36.) New York: WW. Norton & Company.

Sachs, W. (1999). *Planet dialectics: explorations in environment and development.* New York: Zed Books.

Schaumburg Jr. G.W. & Doyle, K.T. (1994). *Wasting resources to reduce waste: Recycling in New Jersey.* Retrieved: September 2, 2005, from http://www.cato.org/pubs/pas/pa-202es.html

Secretariat of the Basel Convention. United Nations Environment Program. (n.d.) *The Basel ban.* Retrieved: March 7, 2005, from http://www.basel.int/pub/baselban.html

Seldman, N. (2003, November). From solid waste management to sustainable economy. *BioCycle ,44* (11), 60-62. Retrieved: June 2004, from ABI/Inform database.

Selke, S.E.M. (2003). Plastics in packaging. In A. L. Andrady. (Ed.), *Plastics and the environment.* (pp.139-184). Hoboken, New Jersey: John Wiley & Sons.

Sheehan, B. & Spiegelman, H. (2005). *Extended producer responsibility policies in the United States and Canada: history and status.* Retrieved: August 24, 2005, from http://www.productpolicy.org/resources/

Singleton, R., Straits, B.C., Straits, M.M., & McAllister, R.J. (1988). *Approaches to social research.* New York: Oxford University Press.

Solving the plastics crisis. (1988). *The Futurist, 22* (4), 60.

Spiegelman, H. & Sheehan, B. (2005). *Unintended consequences: municipal solid waste management and the throwaway society.* Retrieved: August 24, 2005, from http://www.productpolicy.org/resources/

Strasser, S. (1999). *Waste and want: A social history of trash.* New York: Metropolitan Books.

Tabb, W.K. (2002). *Unequal partners.* New York: The New Press.

Tacey, L. (1996). US companies accused of 'dumping' waste cargoes. *Nature, 382,* 484.

Talley, W. K. (2003). Environmental impacts of shipping. In D.A. Hensher and K.J. Button (Eds.), *Handbook of transport and the environment.* (pp. 279-291). San Diego: Elsevier.

Tammemagi, H. (1999). *The Waste crisis: landfills, incinerators, and the search for a sustainable future.* New York: Oxford University Press.

Taylor, J. (1992, February 24). *Recycling is not the answer.* Retrieved: September 2, 2005, from http://www.cato.org/research/articles/taylor-920224.html

Taylor, J. (1997, April 25). *Minimum content: minimum sense.* Retrieved: September 2, 2005, from http://www.cato.org/dailys/4-25-97.html

Tierney, J. (1996, June 30). Recycling is garbage. *New York Times.* Retrieved: September 4, 2005, from http://www.nrdc.org/cities/recycling/recyc/appenda.asp

Tietenberg, T. (2004). *Environmental economics & policy.* (4th ed.) Toronto: Pearson/Addison Wesley.

United Nations Conference on Environment and Development (UNCED). (1992). *Agenda 21.* Retrieved: August 2004, from http://www.un.org/esa/sustdev/documents/agenda21/english/agenda21chapter4.htm

United States Environmental Protection Agency. Office of Research and Development. (2003, February). *Life-cycle inventory data sets for material production of aluminum, glass, paper, plastic, and steel in North America.* [Prepared by RTI International].

Wachtel, P.L (1998) Overconsumption. In K. Roger, D.V. J. Bell, P. Penz & L. Fawcett (Eds.) *Political ecology: Global and local.* (pp. 259-271) New York: Routledge.

Welch, C. (September 28, 2004). Bush cut some diesel pollution but let big ships keep spewing. *Seattle Times Online.* Retrieved: October 4, 2005, from http://seattletimes.nwsource.com/html/nationworld/2002048167_bushship28m.html

Williams, P. (2002). Emissions from solid waste management activities. In R.E. Hester, & R.M. Harrison (Eds.), *Environmental and health impact of solid waste management activities.* (pp. 141-170). Cambridge: The Royal Society of Chemistry.

Wong, M.H. & Chui, V.W. (1990). Toxicity tests of soil contaminated by recycling of scrap plastics [Abstract]. *Biomedical and Environmental Sciences, 3*(1), 81-89

World Wildlife Fund (2004). *Living planet report.* Retrieved: April 3, 2005, from http://www.panda.org/downloads/general/lpr2004.pdf

Saint Mary's University
Halifax, Nova Scotia
Canada B3H 3C3

Patrick Power Library
tel 902.420.5534
fax 902.420.5561
web www.stmarys.ca

Research Ethics Board Certificate Notice

The Saint Mary's University Research Ethics Board has issued an REB certificate related to this thesis. The certificate number is: 04-105

A copy of the certificate is on file at:

Saint Mary's University, Archives
Patrick Power Library
Halifax, NS
B3H 3C3

Email: archives@smu.ca
Phone: 902-420-5508
Fax: 902-420-5561

For more information on the issuing of REB certificates, you can contact the Research Ethics Board at 902-420-5728/ ethics@smu.ca .