SPECIAL REPORT

TD Economics

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THE GREENING OF THE CANADIAN ECONOMY

Highlights

- Despite the growing body of literature, the term 'green economy' lacks a consistent definition. Narrow approaches to defining the term tend to set sectors of the economy at odds by creating a 'green-brown' dichotomy.
- We advocate a broad, holistic approach using a definition of 'the *greening* of the economy,' wherein efforts to improve environmental conditions are motivated by government environmental policy, environmental and economic efficiency, and corporate responsibility.
- Applying this definition to Canada, we find a four step greening process that is common across all sectors of the economy. This process suggests that environmental considerations have become heavily entrenched into the behaviour of Canadian firms.
- Sector characteristics influence how firms approach greening. By undertaking a case study analysis of autos, unconventional oil and the mining sector, we find that demand elasticity, collaboration and international trade considerations can shape greening efforts.
- A key finding is that environmental initiatives and economic growth are not alternatives, but rather increasingly can complement one another.

People apply the term 'the green economy', to a wide range of activities – everything from cleantech and renewables, to job creation, and public policy. However, the fact remains that there is no standard definition of the green economy. Consequently it is difficult to measure performance and assess progress. Moreover, the narrow approach of defining some economic sectors as 'green' and others as 'brown', often excludes many green activities or initiatives being undertaken in sectors outside the 'green economy' umbrella.

We contend that a more useful approach is to put aside the notion of 'the green economy' and instead focus on 'the greening of the economy' as a basis for assessing the progress being made by businesses and individuals to achieve economic growth with environmental benefit. Once one accepts a broader 'greening of the economy' definitional approach, several trends become apparent about the relationship between the environment and the economy in Canada:

1. Environmental considerations are increasingly embedded into corporate decision making;
2. Improving environmental efficiency frequently results in cost advantages;
3. Incentives to reduce environmental impact can be a strong driver of innovation; and
4. Corporate responsibility is a driver for improving environmental performance.

Unfortunately, data constraints prevent a traditional quantitative analysis of the greening of the economy. Instead, this report uses qualitative analysis to describe the greening process and illustrates the progress being made through case studies of selected industrial sectors. The purpose of this paper is not to refute the view that Canada needs to do more on conservation, emissions, sustainability – because

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the country does. The goal is to illustrate how heightened environmental awareness is having a positive impact on environmental outcomes and highlight how green initiatives are increasingly complementing economic growth.

The environment and the economy

Canada has a resource-abundant modern industrialized economy, which carries with it a significant environmental footprint. From fur trapping in the 1600s to modern forestry, mining and oil and gas extraction, the development of the commodity sector has always played a key role in Canadian economic development and economic growth. And while the country is transitioning over time towards a more services and knowledge-based economy, the commodity sector still comprises 15%-to-20% of GDP, and is a major source of jobs (both directly and indirectly), income and exports across all provinces and territories. It also provides significant revenues to governments that are used to help fund social priorities – including, education and health care.

Beyond the expansion of the resource sector, Canadian households and industry also have a large environmental footprint. This partly reflects the nature of Canada as a highly urbanized and industrialized economy, with cities spread across a large geographic space that experience cold weather conditions for large parts of the year. Increased industrial output, greater population and higher energy demands have had significant environmental consequences.

Over the past several decades, the world has become increasingly conscious of the environmental impact of human activities and the potential implications for future generations. The green movement has blossomed from fringe thinking in the 1960s into mainstream consciousness. This greater awareness has had the positive result of creating public pressure for more environmentally-sustainable economic policies.

Canadians have a high level of environmental awareness. Over the past 20 years, national surveys have consistently shown high levels of concern about environmental conditions. However, Canada's environmental policy in recent years has been criticized for not doing enough to abate the environmental impact from economic development and activity. Much of this criticism has been associated with large-scale development of Canada's unconventional oil resources. While contributing just 2% to global carbon emissions, Canada has one of the highest carbon emissions per capita.

The recent negative perception of Canada masks many positive developments that have been taking place across the economy. Businesses have responded strongly to demands by consumers and investors to be more environmentally sustainable. In fact, many businesses now recognize that more environmentally-sustainable policies and practices are not just good for their brand and reputation, but they can also lead to cost savings, and new revenue generation opportunities.

Problems with defining the green economy

There is no general consensus as to what defines a green economy. Various definitions tend to agree on theme, but disagree on scope. The common theme that unites existing

Subset definitions of green economy

Subset definitions consider 'the green economy' as entity within the entire economy at large. While these definitions have the advantage of supporting quantitative analysis, their exclusionary nature can marginalize the efforts to reduce environmental impacts from sectors not deemed to be within the green economy. Examples of a subset approach to 'green' are:

The 'Green Economy' is the aggregate of all activities operating with the *primary* intention of reducing conventional levels of resource consumption, harmful emissions and minimizing all forms of environmental impact. The green economy includes inputs, activities, outputs and outcomes as they relate to the production of green products and services.

ECO Canada (2010)

Green jobs are jobs within industries and businesses that have a positive green impact (or at least a significantly lower negative impact than their rivals) which are most able to capitalize on the growing governmental, business and consumer desire to minimize and mitigate humans' effect on the environment.

Vancouver Economic Comission (2010)

A green job is one whose predominant function serves one or both of the following goals: conserve energy or reduce pollution. This includes clean energy alternatives, products or services designed to conserve energy and other natural resources and efforts prevent, reduce, control or measure environmental damage.

US Department of Commerce (2010)

definitions is rooted in the consciousness for the condition of the environment and its relationship with economic activity. Despite this commonality, definitions of the green economy can mean very different things depending on the context in which they are used.

- Definitions involving developing countries typically focus on social issues, such as resource development, economic growth and their implications with respect to human rights or income equality.
- Environmental research employs the term to describe utilizing resources within their natural carrying capacity (i.e. the ability of nature to replenish itself).
- Economic and policy research focuses on 'environmental goods and services,' applying the term as a label for certain jobs and activities within specific sub-sectors of the economy.

The scope of green economy definitions tend to fall into one of two categories: subset definitions or systems definitions. (Examples in the text box on previous page and below).

Subset definitions of green economy

Subset definitions, which consider the green economy as a distinct portion of the economy as a whole, have the benefit of providing a clear and explicit definition of what constitutes the 'green sector' and a 'green job.' This is advantageous because existing economic metrics can be used to describe the size, status, impact and direction of the green economy. Subset definitions also work particularly well when attempting to quantify the value of green economies, such as the contributions of green jobs to GDP. The primary disadvantage of subset definitions is that they are often too narrow and create a green-brown dichotomy, wherein green efforts of 'brown' sectors become marginalized or ignored. The implication of this is that subset definitions only account for the direct values of the goods, services and jobs produced within green sectors. The economic value and environmental impact generated by businesses that utilize the goods and services produced by these sectors are not accounted for. Studies that incorporate these definitions are typically trying to obtain specific quantitative results regarding the size of the labour force, job creation and contribution of green sectors to GDP.

Although subset definitions can employ currently available metrics for analysis, they are vulnerable to data compatibility issues. Traditional statistical classification systems do not have categories for green jobs or industries. With no standard rubric for defining a green job or industry, each piece of research must define criteria and then see how existing sectors within the North American Industry Classification System fall into them. A consequence of this is that 'green' becomes a relative term and comparing across studies, or over time, becomes challenging if differing methodologies were used.

The bottom line is that while subset definitions provide better scope for measurement of 'green' activities, data and measurement is still a problem. The narrow definition of the subset inherently leads to an under-reporting of the extent to which 'green' activities are taking place.

Systems definitions of green economy

Systems definitions take a holistic approach to defining 'the green economy' by acknowledging the complex set of interrelations between the environment and the economy. These definitions account for efforts taken to minimize environmental impact throughout the economy as a whole. Examples of systems approach to 'green' are:

A green economy is one that results in improved human well-being and social equity while significantly reducing environmental risks and ecological scarcities. In its simplest expression, a green economy is low-carbon, resource efficient and socially inclusive. In a green economy, growth in income and employment are driven by public and private investments that reduce carbon emissions, pollution, enhance energy and resource efficiency and prevent loss of biodiversity and ecosystem impact.

The United Nations Economic Programme (2011)

A green economy fosters economic growth and development while ensuring the natural assets continue to provide the resources and environmental services on which our well-being relies on.

OECD (2011)

Canadians feel a green economy should ensure fairness, equity and address unjust disparities via a systems-based and holistic, approach. It should integrate all three spheres of sustainability, strengthening resilience and reducing vulnerability.

Canadian Institute of Environmental Law and Policy (2011)

Systems definitions of green economy

Systems definitions take a holistic approach to defining the green economy and have a much broader scope than the subset approach. They embrace the concept that all facets of an economy are related to the environment and that efforts can be made by any sector to increase efficiency and minimize environmental impact. Systems definitions have the advantage of being able to identify trends that span multiple sectors within the economy.

By viewing environmental impacts at a systems level, one considers the *total* impact of a technology, product or policy as opposed to only considering impact at end use. This gives a much clearer picture of where efforts in the economy are being made and identifies areas where changes in policy, technology or behaviour could be effective.

The primary disadvantage of systems definitions is the difficulty they have in producing quantitative results. This is due to the incorporation of components that are difficult to measure using currently available data.

Towards a better definition

In the opinion of TD Economics, we need to stop thinking of '*a*' green economy or '*the*' green economy and start thinking in terms of the '*greening*' of the economy. That is, we must consider efforts to reduce environmental impact at a systems level. So what would be an appropriate systems definition? After considerable thought, we would propose the following:

The aggregation of consumer, corporate and policy efforts to increase operational efficiency and minimize environmental impact while fostering economic growth, diversification and competition.

This definition allows an evaluation of how Canada is adjusting its environmental performance alongside its economic performance. It respects the influence of Canada's geographic makeup and developed economy status on environmental performance. It captures the desirability of balanced and broad-based growth, rather than dependence on one particular sector. It is also inclusive of efforts undertaken throughout the entire economy without creating a green/brown dichotomy.

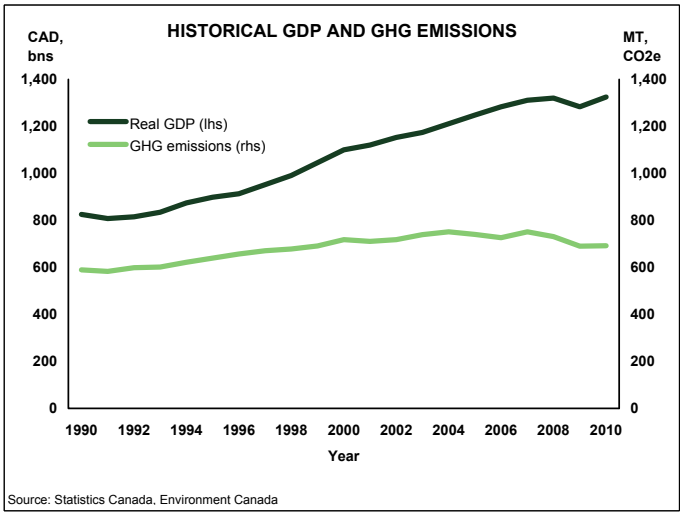
A framework for assessing greening

Armed with the appropriate definition, how can one assess the greening of the economy? The comprehensive nature of the assessment requires a framework from which the relationship between the environment and the economy should be understood. Our framework suggests greening efforts are shaped by the three main factors:

- *Government environmental policy*: describes the set of economic and environmental policy that places appropriate constraints or requirements on economic activity, often reflecting the fact that environmental considerations are not reflected in market prices or other market considerations;
- *Environmental and economic efficiency*: describes the mechanism through which economic and environmental decisions are made and how the impacts of those decisions are measured, and;
- *Community preference and corporate responsibility:* refers to the two-way relationship between consumers and corporations that influence business practices and shape greening behaviour via public opinion and market forces.

Government environmental policy

The existence of market failures with respect to the environment is well documented. These failures are due to the lack of free market mechanisms that price the environmental impacts (i.e. externalities) of industry into the market. Regulation can mitigate these failures by creating mechanisms that impose restrictions or costs on adverse environmental performance or actions. Regulation can create a system of guidelines and incentives to reduce environmental impacts while maintaining economic benefits. Government policy provides incentives to diversify, innovate and reduce impact through: emissions standards, taxes, tariffs and subsidy schemes. A holistic evaluation of regulation and public policy must be performed with full consideration of its implication throughout the economic and environmental spheres. Although government policy is essential to improving environmental performance, intervention in the market can potentially result in severe economic ramifications and inefficiencies. In other words, one needs well-designed environmental policy to put in place the right incentives to achieve desired goals.



Environmental and economic efficiency

The greening of the economy considers both environmental and economic efficiency at the core of its decision making process. Environmental efficiency encompasses enhancing both resource use and environmental quality in the short and long term. It is achieved through the responsible management and utilization of resources, minimization of waste, and actively seeking to improve environmental performance. Economic efficiency is concerned with maximizing economic growth and prosperity in both the short and long term. This entails utilizing labour, materials, technology and techniques to minimize costs and maximize output to whatever extent is economically feasible.

Evaluating the combined economic and environmental impact simultaneously creates a system of checks and balances that places emphasis on total benefit. Corporations must balance economic and environmental benefits/costs, as opposed to strict profit maximization, meaning that they may forego some profits in the short run to reap benefits in the long run. Thus, this environmental element introduces a new priority in the corporate decision making process: improve environmental efficiency while maintaining or boosting economic efficiency.

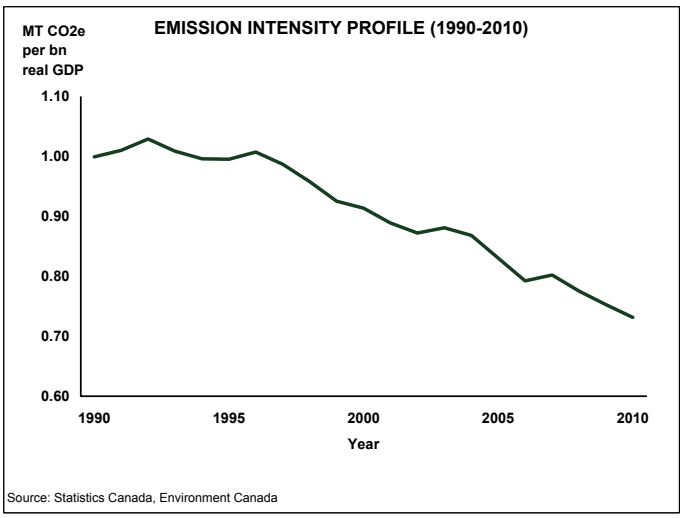
Consumer preference and corporate responsibility

There's a two way relationship between consumer preference and corporate responsibility that motivates greening. Consumers are concerned with more than just the products and economic benefits provided by corporations. They're also concerned with how businesses impact the lifestyle and well-being of themselves and others. Thus, consumers motivate green business practices by demanding responsible products, practices and granting approval or social license of businesses conduct. Disapproval from consumers can seriously delay, or halt projects all together. In the other direction, corporations motivate the greening of consumers and competitors. Responsible business models can give corporations a competitive edge over their peers, and, in turn, consumers demand other corporations hold themselves to the same green standard. What's more, corporate responsibility drives greening in consumers through environmentally-friendly products and community outreach programs.

Evaluating performance

So, now that we have a definition and a framework for discussing 'the greening of the economy', how is Canada doing? It may surprise many to learn that, at a high level, we're witnessing a decoupling of economic growth from environmental degradation. Historically, GDP growth and GHG emissions have exhibited an incredibly strong positive correlation of almost 1-to-1. Post 1997, this correlation weakened significantly to the point where a 1 percent increase in GDP is associated with a 0.44% increase in GHG emissions (see chart on left). Although absolute emission levels have increased since 1990, emission intensity has fallen by 30% (See chart below). Despite the large amount of economic growth in the past 20 years, we've witnessed improvements in Canada's air quality, water quality, recycling rate and protected lands (See Appendix 1).

While this looks great on the surface, these macro



indicators don't tell the whole story. Without undertaking a deeper industry level analysis, we cannot demonstrate how effective greening efforts by businesses have been. Unfortunately, the ability to evaluate greening efforts at the industry level is hindered by a lack of necessary data.

Canada would benefit substantially from collecting more data on key indicators showing the greening of the economy, as the data would allow for thorough analysis of the impact and perceptions of environmental performance, which would result in more effective policy formation. It could also help improve Canada's environmental reputation in the international context, which has significant implications for improving international trade and relations.

The following section will suggest the appropriate indicators to be utilized when assessing the degree of greening within Canada as well as proper techniques for evaluating performance.

Indicators

The above framework suggests three categories from which greening should be understood: government policy, environmental and economic efficiency and corporate responsibility. With this framework in mind, the following is a non-exhaustive list of suggestions for relevant micro and macro level indicators. (See Appendix 2)

- *Environmental indicators:* describe environmental quality and performance related atmospheric contaminants, GHG emissions, water, land use and biodiversity
- *Economic indicators:* useful at the industry and national level. They include characteristics, such as revenue, costs, market share, raw inputs utilized and output produced. Indicators of efficiency and disposition are concerned with how businesses are using materials.
- *Government policy indicators:* describe the structure, stringency and effectiveness of regulation and national policies concerning environmental performance.
- *Corporate responsibility indicators:* measure the impacts of regulatory and stakeholder pressure as well as philanthropic efforts.

Measurement Techniques

In order to measure the impact of greening efforts, holistic techniques that account for both the economic and environmental elements of impacts must be used. As such, these techniques tend to place an emphasis on relative performance, rather than absolute performance (See table above for list of suggested techniques). Two examples are benchmarking and life cycle assessment. Benchmarking involves comparing current performance to historical performance, within or between entities. An advantage of benchmarking is that it respects the specific characteristics of products, services and polices without setting absolute goals which ignore the economic context of environmental impact mitigation. Benchmarking intensities of production is a good way of measuring progress and demonstrating efficiency gains while respecting the specific characteristics of a sector that influence performance.

Measurement techniques	
Life cycle assessment	Triple bottom line accounting
Benchmarking	Systems modeling
Environmental impact assessment	Cumulative effects assessment

Life cycle assessment (LCA) is a more complex undertaking as it involves systematically tracking the environmental and economic impact of a product or policy at each stage in its life cycle to give an aggregated total assessment. A key advantage of LCA is the ability to measure environmental impact at a systems level.

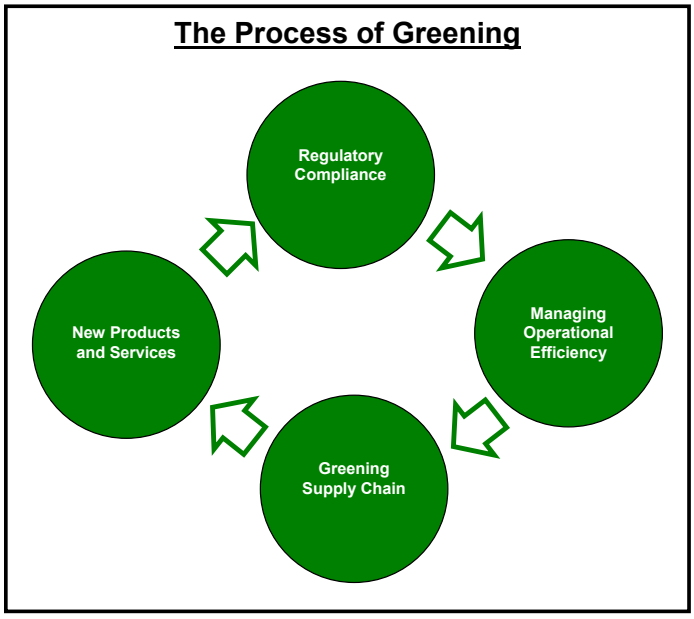
The techniques and indicators included here are suggestions for evaluating, tracking and quantifying greening efforts within Canada. They provide the context for the continual assessment of the impact that Canadian business have on the environment. These suggestions are not without fault, the main challenge is the lack of an agreed upon standard for collection and aggregation of the information. Again, the difficulty is the inability to quantify the greening that is taking place. Nevertheless, in lieu of a quantitative analysis, a qualitative approach can provide considerable insight and demonstrate that progress is, in fact, being made.

The greening process

While specific initiatives vary from sector to sector, there is a four step process of greening that is common across sectors of the Canadian economy (See diagram on following page):

(1) Regulatory compliance;

(2) Managing operational efficiency;



(3) Greening supply chain;

(4) New products and services.

The level of involvement in this process depends on various factors, such as: sector-specific market conditions, consumer demand, corporate support and economic feasibility. Cost may be a prohibitive factor in implementing these strategies as each step of the progression tends to be more expensive than the last. The two most expensive steps – greening the supply chain and implementing new products and services— are unique as they have the potential for creating a virtuous cycle which fosters the greening in other companies or industries that would not have otherwise.

Step 1: Regulatory compliance

Regulatory policy plays a foundational role in improving the environmental performance of Canadian companies. Since regulatory compliance is mandatory, it is the first step in greening that a company takes and it is often viewed as the baseline or benchmark from which greening efforts of a business are evaluated. Important drivers motivating companies to move beyond regulatory compliance are the perceived cost advantages and branding that can be achieved through improving operating efficiency and corporate responsibility.

Step 2: Managing operational efficiency

Operational efficiency refers to resource use, operating expenses, and environmental impact. The first step in the process is data collection. The demand for transparent and consistent information on resource use and environmental performance by regulators and stakeholders has increased pressures to adopt sector-specific or universal reporting criteria. These are available from many sources; such as Global Reporting Initiative, industry guidelines such as 'Toward Sustainable Mining' (Mining Association of Canada), and the Greenhouse Gas Protocol (World Resources Institute and the World Business Council for Sustainable Development).

The information collected in this process provides a basis for understanding business operations and cost implications with respect to environmental performance. Once a company has successfully identified this information, it can implement policies and procedures that improve efficiency, reduce cost and mitigate environmental impact. There are two important implications of this behaviour. First, environmental consciousness becomes embedded into the corporate production, development and decision-making processes. Second, contrary to conventional wisdom, improving environmental performance can often result in the creation of cost and competitive advantages.

Environmental management systems (EMS) are the predominant mechanism through which Canadian companies manage operational efficiency. By integrating environmental considerations into the business process, companies are able to find efficiencies in upgrading capital stock, improving waste and resource management techniques and conservation, which result in delivering products and services at a lower cost. EMS's can be developed in house or by a third party as universal/industry specific guidelines for environmental management. Examples of third party EMS guidelines in Canada are the ISO 14000, ISO14001:2004, EMAS, and CSA environmental management.

Step 3: Greening business processes and supply chains

The third step of the greening process involves extending policies and practices throughout the supply chain. Large corporations with highly structured supply chains have the ability to push greening efforts throughout the product life cycle. They do this by demanding certain criteria be met regarding the environmental aspects of their products. Green supply chain techniques typically focus on reducing waste, utilizing recycled and environmentally friendly materials as well as improving logistics throughout the product life cycle.

A virtuous cycle is created when corporations push greening efforts throughout their supply chain. Corporate buyers sometimes invest in the infrastructure and capabilities of their suppliers in order to create an end product that is more efficient and environmentally-friendly than its predecessor, thereby capturing a larger market share through product differentiation and improving brand reputation. Similarly, large corporations may forego capital investment and simply demand suppliers meet an environmental standard in their production process. In order to remain competitive and preserve market share, suppliers who previously lacked greening incentives will adjust behaviour and practices according to the first two steps of the process by meeting regulatory guidelines and improving operational efficiency.

Green supply chain management practices are proven to be beneficial for most 'Best-In-Class' businesses within the logistics, transportation, manufacturing, retail and consumer goods sectors in Canada. Green supply chain management practices also differentiate products through certification programs that verify a standard of environmental performance; such as the Forest Stewardship Council, and the Ocean-Wise program.

Step 4: Develop new products and services

The fourth step, which is by far the most cost intensive, expands its scope to consider driving change throughout the market as a whole by developing:

- New markets and delivery platforms;
- New products and services;
- New business models;
- Collaborative efforts and industry associations.

The development of new technologies and materials is drastically altering how businesses present themselves. Identifying, innovating and capitalizing on environmentally-efficient techniques create new markets and business models. For example, oil and gas companies are revamping business models to become integrated energy companies. This entails diversifying into renewable energy sources, fuel and utilities. Another example would be automotive manufacturers providing transportation services through auto-share programs. When successful, these changes also create opportunities for a virtuous cycle to occur, as companies in this new market seek to evaluate and improve efficiency and environmental performance.

Collaborative efforts, such as research initiatives and industry associations, create a new platform for improving environmental performance. Industry associations can make social responsibility pre-requisites a mandatory condition for membership, while research initiatives pool the minds and resources of industry leaders to develop solutions for environmental issues. Again, the virtuous cycle is perpetuated. If businesses want to partake in the benefits of collaborative efforts, they must commit to a standard of conduct and social responsibility.

The broad implication of this final step is that demand for improved environmental performance is driving innovation, job creation and growth throughout the economy.

Implications of the greening process

Our description of the four stage process of 'greening the economy' provides evidence for the following conclusions about the relationship between the environment and the economy in Canada:

1. Environmental considerations are increasingly embedded into corporate decision making;
2. Improving environmental efficiency frequently results in cost advantages;
3. Incentives to reduce environmental impact can be a strong driver of innovation;
4. Corporate responsibility is a driver for improving environmental performance.

The above conclusions are relevant for all sectors throughout Canada, but not uniformly so. The specific characteristics of each sector influence how they go about greening.

Case studies illustrate the greening of the economy

We have a definition, a framework and an understanding of how greening the economy takes place. The ideal next step is to demonstrate the progress being made. However, as articulated earlier, Canada's statistical systems are not conducive to a quantitative evaluation. We can, however, provide a qualitative examination of several sectors of the economy that have a significant environmental footprint to illustrate the greening that is occurring.

Due to differences between each sector of the economy, efforts to mitigate environmental impact may be more

pronounced in some areas than others. This asymmetry can be the result of the different environmental priorities of a sector, the nature of the industry or the economic feasibility of mitigating environmental impact. The following section analyzes how our conclusions about the relationship between the environment and the economy in Canada are influenced by industry specific characteristics.

We have applied a simple modest, moderate, high rating criteria (See Appendix 3). It is important to note that these case studies are not to be used to compare performance across sectors. That is to say, the rating does not imply one sector is greener than another. Asymmetries in the specific characteristics of industries make comparison across sectors difficult, as they have different limiting factors. The rating should be interpreted as indicators of the degree to which industries are incented to improve their environmental performance.

CASE 1: CANADIAN AUTO MANUFACTURING

Automotive assembly comprises the largest component of Canada's manufacturing sector. In 2011, it accounted for just over 9% of Canada's manufacturing GDP and about 1% of total GDP. Canada produced just over two million vehicles, which accounted for 16% of North American production. About 85% of Canadian-produced light vehicles are exported and almost 90% of these exports are directed towards the United States. Manufacturing and exporting products internationally exposes the automotive manufacturing industry to a host of environmental issues.

Environmental considerations are increasingly embedded into corporate decision making

Rank: Moderate

All five major vehicle manufacturers with assembly plants in Canada currently collect environmental performance statistics that are publicly available through dedicated websites, corporate social responsibility reports or sustainability reports. These producers also have environmental management systems in place in at least one of their Canadian facilities, with ISO 14001 being the industry standard. By making data publicly available, manufacturers are able to track and develop resource management programs as well as demonstrate their brand commitment to improving environmental performance. As further proof of commitment to the environment, auto manufacturers publicly provide transparent, third party verified goals and environmental progress reports.

As a result of the large amount of vehicles being exported, manufacturers are bound by multiple North American and international environmental regulations in order to be eligible to sell vehicles in North American and global markets.

Improving environmental efficiency frequently results in cost advantages

Rank: Moderate

Improving environmental performance through retrofitting plants and adopting new production procedures is economically feasible and has resulted in cost advantages for some manufacturers. Manufacturers who have programs to optimize resource use, waste management and logistics have improved environmental performance and reduced operating costs. By implementing a North American logistics management program, one auto manufacturer increased fuel economy by 7%, decreased carbon emissions by 15% and saved $10 million in operating costs during the program's first year.

Efforts focused on the efficient management of factory and office space have resulted in manufacturers upgrading and retrofitting buildings with modern efficient features. Despite the large capital investment it takes to retrofit plants and office buildings, one producer reported their LEED certified operations generates a $1.26 million/year energy cost savings when compared to similar buildings.

Modern vehicles are designed to have their components recycled at the end of their life cycle. Some manufacturers are reporting up to 96% of vehicle materials reused by volume, which diverts a large amount of waste and reduces the costs of inputs.

Recycling of input materials has significantly reduced the amount of water used in the auto production process. One producer avoided the consumption of 68,000m^3 of water through a resource management initiative. Similarly, another manufacturer reported their waste management and recycling program was able to divert 1.3 million kilograms of landfill materials, while maintaining a $39,000 annual cost saving.

Incentives to reduce environmental impact can be a strong driver of innovation

Rank: Moderate

Rising fuel prices and concerns regarding environmental

Electric car rebate programs	
Province	**Program**
Alberta	Green Trip
British Columbia	LiveSmart
Manitoba	EV Road Map
Quebec	2011-20 Action Plan for Electric Vehicles

impact has driven innovation in the design and manufacture of automobiles. A significant portion of this innovative effort is dedicated to bringing alternative fuel technologies to the mainstream consumer. Alternative fuel technologies are still in their infancy and are slowly beginning to penetrate the traditional market. Electric vehicles are expected to account for up to 10% of world automobile sales by 2025, with hybrid vehicles expected to obtain a 40% total market share. Natural gas vehicles are expected to compose larger portions of fleet and trucking in the future as well. Both the government and industry recognize the huge potential of these alternative technologies, dedicating a substantial amount of capital in order to introduce these new platforms into the market. In the last ten years, expenditure on research and development by manufacturers has averaged $460 million per annum. Government supports innovation through a series of grants and incentives. The Natural Science and Engineering Research Council has committed $23.3 million dollars to automotive research in Canada from 2010-2011. Automotive Partnership Canada has made a five year, $145 million, initiative to foster collaborative research development efforts that support environmental performance and next-generation manufacturing. Furthermore, some provinces have created consumer incentive programs to encourage adopting electric/alternative fuel vehicles (See above table).

Corporate responsibility is a driver for improving environmental performance

Rank: High

In the fast moving and highly competitive automobile industry, branding plays a large role in product differentiation. Manufacturers focus on developing a brand that is associated with quality, efficiency and good environmental performance. As consumers become more sophisticated, corporate responsibility and brand recognition are increasing in importance in consumer decision making. Thus corporate responsibility drives environmental performance by making environmental responsibility a competitive aspect of the market. A lack of concern for the environment can hurt business, as neglecting to improve environmental performance can result in a loss of market share.

CASE 2: CANADIAN UNCONVENTIONAL OIL

Canada holds the third largest reserve of oil in the world, with 173.6 billion proven barrels, 98% of which are held in unconventional sources. In 2011, Canada produced 3.7 million barrels of oil a day, making it the sixth largest producer of crude oil in the world. The IEA has forecasted a 24% increase in world demand for oil by 2035. With the demand for oil expected to grow considerably in the next 20 years, the environmental considerations of Canada's unconventional oil sector is an increasingly important topic. The extraction and upgrading methods for unconventional oil are more environmentally intensive than conventional sources. 'Well-to-wheel' life cycle assessments (LCA's) have placed the GHG emissions of unconventional oil 5%-to-37% higher than conventional sources. As of 2012, crude and refined oil and gas accounted for 25% of domestic Canadian exports, while upstream and midstream unconventional oil extraction accounted for 3% of total GDP.

Environmental considerations are increasingly embedded into corporate decision making

Rank: Moderate-to-High

As an extractive industry, the unconventional oil sector has a significant amount of environmental considerations embedded into project economics, regulation, permitting, operating procedures, and reclamation. There is a high level of both mandatory and voluntary reporting that involves the transparent collection, public disclosure and third-party verification of environmental performance. Voluntary reporting programs such as the Global Reporting Initiative and the Carbon Disclosure Project involve disclosing environmental performance data above and beyond regulatory or permit requirements. Implementing environmental management systems (EMS's) based on ISO14001 standards has given producers a framework to improve efficiency, resource use and waste management. Environmental improvements include utilizing saline water over fresh water in extraction, developing multi-well pads, retrofitting wells with equipment to reduce waste and harmful emissions, and cogeneration technologies.

In 2007, Alberta was the first jurisdiction in North America to develop a mandatory regulatory structure that

places a tax on large emitters of GHG's. Alberta's Specified Gas Emitters Regulation applies to businesses that emit more than 100,000 tonnes of GHG emissions annually. It offers emitters a menu of choices: reduce emission intensity by 12%, pay up to $15 per tonne of GHG beyond a specific quota into a technology fund, or purchase carbon offsets. Federal regulation, such as the National Pollutant Release Inventory, requires producers who meet criteria to record and report pollutant releases. These documents are made available to the public. Incentives exist to improve environmental performance beyond regulatory standards, as offsets at some projects can be used against future performance or other projects.

Improving environmental efficiency frequently results in cost advantages

Rank: Modest (but could increase with time)

Many of the environmental technologies under development cannot be implemented in an economically feasible manner at the present time. Technologies such as carbon capture and storage are in their infancy. Furthermore, operating costs of unconventional oil projects vary significantly based on the characteristics of the operation (i.e. location, proximity to resources and support infrastructure, extraction technique, geological formation etc.). Consequently industry-wide implementation may not be possible due to varying project economics.

Water use is significant in unconventional oil extraction. Producers are making efforts to minimize water use through recycling. This not only reduces freshwater withdrawal, it also reduces the amount of water that would ultimately end up in tailings ponds. One producer reports eliminating the need for three million litre of freshwater by developing a saline wastewater holding facility at a gas plant, despite being approved to withdraw the freshwater by regulators. This water, which would normally be sent for disposal, was transported a short distance to a bitumen project where it was used in the extraction process. This procedure, which was ultimately cost neutral, reduced GHG emissions and recycled a significant amount of waste materials that otherwise, would have been disposed of. Another producer reported a 78% recycle rate of water from surface mining projects and a 90% recycle rate at situ projects. Beyond enjoying considerable cost savings, the producer also reduced oil sands water intensity by nearly 40%. By recycling water, unconventional oil producers are able to keep their steam oil ratios low, meaning less natural gas is required to heat water and generate steam for extraction. It also reduces emissions of CO2 and other particulates. This offers cost savings on electricity, natural gas and water.

These advantages become more pronounced when combined with other technologies, such as cogeneration. Cogeneration simultaneously generates electricity and steam, thereby reducing energy costs and emissions. Emissions from cogeneration technologies are 40% lower than traditional methods. Cogeneration also offers a significant cost advantage, since the natural gas used for generation can often be obtained during the extraction process and does not have to be purchased.

Although the cost advantages are deemed to be modest at the moment, it is worth stressing that technical progress should present greater cost saving opportunities over time as the barriers to application and implementation should decline with time.

Incentives to reduce environmental impact can be a strong driver of innovation

Rank: High

The unconventional oil industry is at the forefront of improving environmental performance through innovation. Individual producers, governments and industry associations have made significant investments into research and development (R&D) for environmental impact mitigation technology. The Canadian Oil Sands Innovation Alliance (COSIA) is an industry association that consists of 14 large oil and gas producers, which represent over 80% of Canada's oil sands production. COSIA invests in collaborative research and innovation in four primary areas: tailings, water, land and greenhouse gasses. The Oil Sands Leadership Initiative is a $25 million collaborative initiative between unconventional oil producers that develops solutions to non-competitive industry issues, such as environmental performance. Government support has also driven innovation in the unconventional oil sector. For example, the Alberta government committed $1.3 billion to developing carbon capture and storage technology.

R&D efforts have resulted in significant technological advances that prioritize efficiency and reduce environmental impact. Flue gas recirculation, heli-portable drilling, solvent aided extraction processes and biodegradable industrial lubricants are just a few examples. Flue gas recirculation technology recycles exhaust fumes from steam generators

for cooling burner flames. This recirculation process reduces nitrous oxides emissions by 50% and increases overall mechanical efficiency. Heli-portable drilling rigs, a technology that has been used in the mining sector for decades, has been adopted in the unconventional oil sector. These rigs which are transported in via helicopter significantly reduce environmental impact associated with extraction infrastructure as well as reduce water consumption by 50%.

Corporate responsibility is a driver for improving environmental performance

Rank: Modest (for the firm)/High (for the industry)

From a traditional economic perspective, primary good businesses (such as the energy sector) tend not to compete based on environmental performance in the same way as other industries. For unconventional oil producers at the individual firm level, inelastic (i.e. non-price sensitive) demand along with a lack of awareness by consumers of the source of crude oil that makes up a refined petroleum product means that there is limited pressure on producers from the threat of consumer substitution in reaction to environmental performance.

However, minimizing regulatory and consultation delay is one of the key incentives for maintaining good environmental performance and corporate responsibility. This is true at the firm level, but it has become an acute issue at the industry level. This is evident in the recent challenges on expanding pipeline capacity. Lack of public support and the implications for future development of the energy sector mean that all unconventional oil producers are under increasing pressure from a corporate responsibility perspective to factor environmental performance into decisions. Indeed, the sector is making a concerted effort to increase public awareness of the environmental practices and policies they are pursuing. While environmental considerations are paramount, it is important to recognize that project delays or prevention can carry significant lost economic opportunities, including income, employment and government revenues.

One of the potential reasons why corporate responsibility may not have been a stronger driver for improving environmental performance in the past is the lack of strong collaborative associations. However, as the sector has run into challenges, there has been a move towards deeper collaborative activity in the sector that could pay off in increased environmental initiatives.

Companies that choose to operate internationally may also face lending restrictions from financial institutions based on their level of corporate responsibility. Financial institutions that subscribe to responsible lending guidelines such as the United Nations Principals for Responsible Investment or the Equator Principals may refuse to lend if businesses do not conduct themselves in a manner consistent with the directive in place.

CASE 3: CANADIAN MINING

In 2012, mining, refining, smelting and the manufacturing of minerals comprised 2.3% of Canada's GDP. Two-thirds of this was from raw mineral extraction, with non-ferrous metals contributing the largest portion. The remaining third was generated in refining, smelting and manufacturing of minerals. As an important player in the global mining and quarrying industry, Canada ranks in the top five for production of 11 minerals and metals, it is home to 16 of the top 100 global mining companies and it accounted for approximately 18% of global exploration spending. Canada's diamond industry underwent tremendous growth from 1998-2008, to become the worlds fourth largest producer. Even with diamond prices falling in 2010, Canada still provided 13% of global diamond production, valued at $2.8 billion. In 2011, exports of minerals and metals accounted for 22% of total goods exported by value in Canada. The United Kingdom, U.S. and China are Canada's top export destinations, receiving 34%, 19% and 12% of exports, by value, respectively.

Environmental considerations are increasingly embedded into corporate decision making

Rank: High

The extraction, smelting, refining and manufacturing of minerals in Canada has environmental considerations heavily entrenched into the corporate decision making process through geography, regulation, industry initiatives and trade considerations.

Canada's mining sector has a unique regulatory structure. Mineral rights fall in provincial jurisdiction, meaning producers have a different set of land use and environmental regulation in each province/territory. Federal environmental regulations that influence corporate decision-making are primarily focused in the areas of tailings, effluent management and emission reporting. Corporations also have

to consider international standards.

The economics and environmental footprint of mines are influenced by geographic location. Mineral producers located in remote areas of Canada make special considerations for environmental impacts associated with transportation to, and powering of, their facilities. Due to lack of access to electric grids, mines in remote areas rely on fuel oil for energy. They also have to transport materials over much longer distances, which results in higher GHG emissions. This places energy efficiency and logistics as key priorities in the decision-making process. As a result, producers develop management systems to efficiently use fuel, energy and logistics to minimize environmental impact and operating costs.

Environmental management systems and industry best practice guidelines are highly developed and heavily entrenched in Canada's mining sector. ISO 14001 based EMS's are commonplace, along with national and international industry environmental initiatives, such as: Extractive Industries Transparency Initiative, Devonshire Initiative, the Kimberly Process and the Green Mining Initiative (GMI). The Mining Association of Canada's Towards Sustainable Mining (TSM) initiative is a performance-based program developed to assist mining companies in evaluating and managing their environmental performance. The TSM's top environmental priorities are relevant throughout the entire mining sector: tailings management, energy use, emission management and biodiversity. The Mining Association of Canada has made participation in TSM a mandatory condition for membership.

Improving environmental efficiency frequently results in cost advantages

Rank: Moderate

Water and tailings management is one of the foremost environmental concerns of Canada's mining industry. By utilizing innovative tailings management and recycling techniques, producers are able to minimize cost as well as water withdrawn from local sources. Layers of sand and crushed rock in tailings ponds allow for water to separate from tailings. This water is pumped out of the pond and reused by the producer. Other techniques, such as storm water capture, reduce the amount of water withdrawn from public sources. These procedures have both cost and environmental advantages when compared to water from other sources.

Energy efficiency is also serious concern within the mining industry. As mines become deeper, the energy required to operate increases. Energy efficiency and conservation programs have successfully reduced GHG emissions and operating costs as well as driven R&D. In 2010, a deep mine operator in northern Ontario reported the retrofitting of a ventilation system in a deep mine. Savings included an estimated 13.3 million kWh of electricity, an annual cost savings of over one million dollars, and a 4% reduction in both energy consumption and GHG emissions. A Canadian refinery was able to avoid 3200GJ of natural gas consumption and 164 tonnes of carbon emissions by implementing operating changes to a top blown rotary converter. Not only did these changes reduce environmental impact, they extended the life of the converter by 60%. Monitoring programs have also improved environmental performance. By utilizing an EMS that collected energy use data at 200 points within a mine, one producer reduced energy intensity by 5% and GHG intensity by 17% through optimizing energy use and recycling waste heat.

Incentives to reduce environmental impact can be a strong driver of innovation

Rank: Moderate

The drive to improve environmental performance has fostered a host of innovative efforts in Canada's mining industry. In 2011, Canadian mining and metal companies invested $590 million dollars into research and development. Canada's mining sector has engaged in a number of large collaborative research efforts with industry, stakeholders and government bodies to improve environmental performance (See table below). Collaborative research efforts focus on key environmental issues, such as: tailings management, energy efficiency, effective exploration, footprint reduction, innovation in waste management, ecosystem risk management and mine closure and rehabilitation.

Resource constraints have resulted in innovative recycling procedures. The mining sector has reduced waste and operating cost through recycling e-waste into urban ore. E-waste consists of discarded electronics which contain metals or chemicals that are hazardous to the environment if improperly disposed of. For example, batteries found in

Collaborative research and innovation initiatives	
Canadian Mining Innovation Council	National Orphaned/Abandoned Mines Initiative
Deep Mining Research Consortium	Canadian Mineral Processors
Mine Environment Neutral Drainage Program	Green Mines Green Energy
Green Mining Initiative	

International and domestic environmental conduct initiatives	
Export Development Canada	World Bank Guidelines
Transportation of Dangerous Goods Act	Equator Principals
Extractive Industries Transparency Initiative	Basel Convention
Devonshire Initiative	International Cyanide Management Code
Kimberley Process	United Nations Global Compact

portable electronics can become toxic when their protective casing is broken. By recycling e-waste, producers recover 'urban ore,' which is used as feedstock for making anode copper. Recovering urban ore from discarded e-waste not only reduces hazardous waste, it also offers cost advantages relative to production from raw minerals.

Diversion of scrap metals also generates economic benefits through trade. Countries like China use scrap metal as a major input in their manufacturing process. Smelting scrap reduces landfill waste and fills the growing international demand for metals. For example, copper has a wide variety of uses and is 100% recyclable. Recycling of scrap copper has become a serious component of the industry and it is estimated that 80% of mined copper is still in use today.

Corporate responsibility is a driver for improving environmental performance

Rank: High

Similar to the unconventional oil and gas industry, Canada's mining sector is a primary goods industry, thus corporate responsibility motivates environmental performance in different ways than in customer-facing sectors. Streamlining the regulatory and consultation processes is the primary incentive for maintaining a high level of environmental performance. Financial institutions and investors also incorporate environmental risk and performance considerations into decision-making. Guidelines for responsible lending, such as the United Nations Principals for Responsible Investment and the Equator Principals, incorporate environmental, social and corporate governance factors into risk assessment and lending. Meaning in order to receive funding for projects, companies must maintain high levels of corporate responsibility (See above table for examples of initiatives).

Collaborative industry associations that have corporate responsibility guidelines as a mandatory prerequisite of membership, such as the Global Mining Initiative's Toward Sustainable Mining, bolster the effectiveness of responsibility as a driver of environmental performance. This is due to the tangible evidence of corporate responsibility in the form of membership. The reputational risk associated with failing to meet membership criteria also provides an incentive to improve environmental performance.

Lessons from Canada's greening industry

There are many lessons from the case studies reviewed above. First, it demonstrates the efforts aimed at greening the economy – specifically, to increase operational efficiency and reduce environmental impact while fostering growth. Second, the industries operate within the greening economy framework that was identified: they are affected by government policy, they make decisions based on environmental and economic efficiency, and corporate responsibility has an influence on the decisions that are taken. Third, the green process runs through the four identified processes: regulatory compliance, operational efficiency greening the supply chain, and new products and services.

The qualitative analysis is less robust than a traditional quantitative approach, but the case study approach also provides some conclusions related to the industrial structure and greening activities. Specifically, the analysis highlights that:

1. Industries with a high level of participation in collaborative initiatives tend to incorporate a high degree of environmental stewardship into corporate conduct and R&D;

2. Foreign environmental policy can drive environmental stewardship in trade intensive industries;

3. Inelastic demand and the absence of collaborative initiatives reduce the effectiveness of corporate responsibility as a driver of environmental improvement, but this effect can be offset by industry-wide challenges or the threat of regulatory action.

Conclusion

A clear understanding of the relationship between the environment and the economy is a necessity to any country that wishes to achieve economic growth while minimizing environmental impact. Defining this relationship narrowly paints an incomplete portrait of environmental performance, as it understates the effort being made to mitigate damage

to the environment. So when it comes to defining the relationship between the environment and the economy, we need to stop thinking of 'a' green economy or 'the' green economy and start thinking in terms of the 'greening' of the economy. That is to say, we need a broad, holistic approach that facilitates a clear understanding of how green initiatives are effectively improving environmental conditions and complementing economic growth. This type of approach is vital for developing equitable and effective solutions to contemporary environmental and economic issues.

It's difficult to think of an issue that impacts current and future generations as substantially as the environment. This is especially true for Canada, where natural endowment is just as important to economic well-being as it is personal well-being. If our definition of the greening of the economy has taught us one thing, it's that the future of Canada's environment is not as bleak as public opinion would have us believe. While there is no doubt that Canada must do more to improve its environmental performance, we need to be careful not to mask the progress industry, government and citizens have made over the years to mitigate their environmental footprint. Rather than being viewed as an impossible task that sets economic growth at odds with the environment, acknowledgement of the strides being made can be empowering. It holds out the promise that even more can be achieved. It is our hope that by changing the way we think about the relationship between the environment and the economy, we can motivate further thought about the opportunities to foster economic growth while preserving environmental integrity, thereby creating a brighter, cleaner future for Canada.

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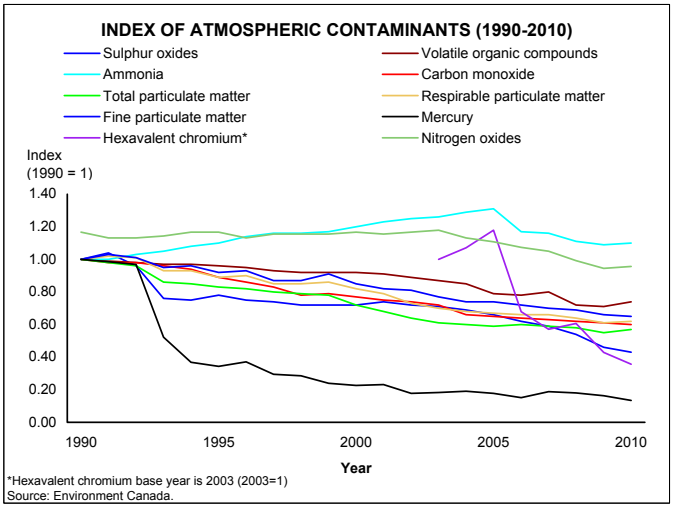
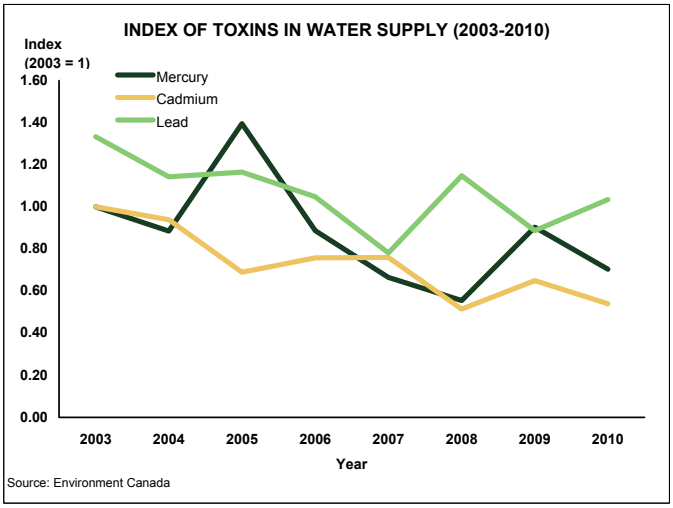
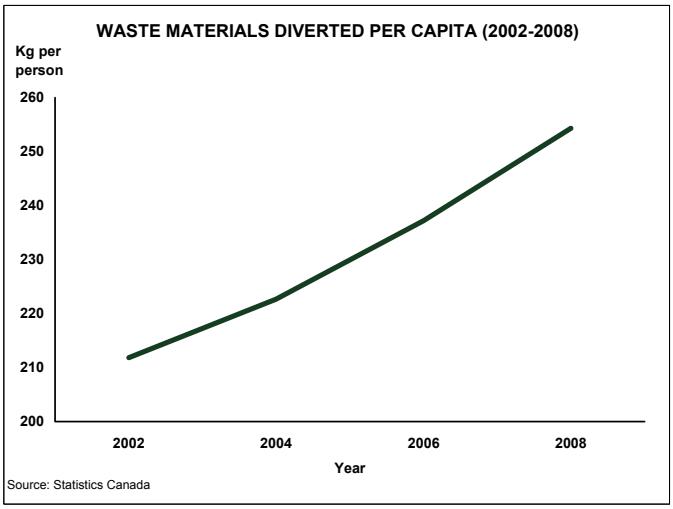
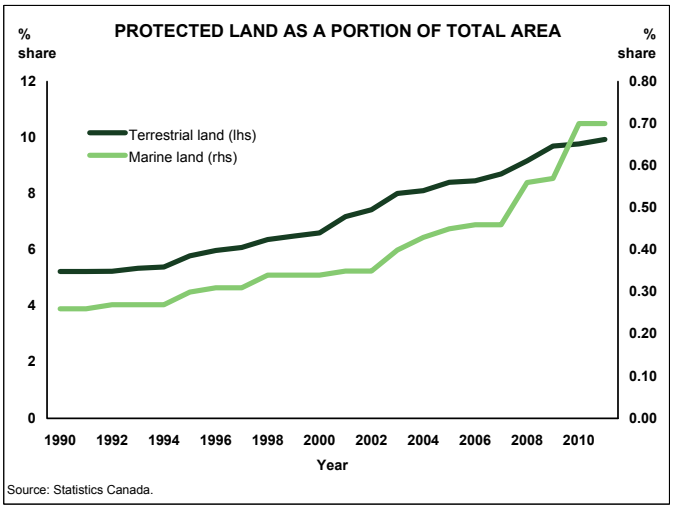
Appendix 1 - Canadian Historical Environmental Performance









Appendix 2 - Suggested Indicators for Analyzing Greening

Environmental Indictors	
Greenhouse Gas Emissions	
Area of concern	**Example of indicator**
Greenhouse gas emissions	Emissions by source
Air Quality	
Area of Concern	**Example of indicator**
Contaminants, smog and suspended particles	Sulphur oxides
	Nitrogen oxides
	Ammonia
	Volatile organic compounds
	Carbon monoxide
	Respirable particulate matter
	Fine particulate matter
	Total particulate matter
Water	
Area of concern	**Example of indicator**
Toxicity	Mercury
	Lead
	Cadmium
Suspended particles	Turbidity
Waste	
Area of concern	**Example of indicator**
Waste materials produced	Landfill waste
	Incinerator waste
	Hazardous waste
	Non-Hazardous waste
Waste materials diverted	Materials diverted
Biodiversity and Protected Areas	
Area of concern	**Example of indicator**
Biodiversity	Land stressors
	Area of ecosystems
	Threatened species
Resource supply	Natural resource reserves
	Natural resource consumption
Protected areas	Protected terrestrial land
	Protected marine land

Economic Indictors	
Economic Performance	
Area of concern	**Example of indicator**
Value generated	Revenue
	Operating costs
	Physical output
	Perceived market share
	Retained earnings
	Number of employees
	Employee compensation
Greenhouse gas emissions	Emissions by source
Efficiency and Disposition	
Area of concern	**Example of indicator**
Resource disposition	Inputs of production
	Energy consumed
	Water withdrawn
	Water consumed
	Area of land utilized
	Fuel consumed
	Resource supply disposition
Waste management	Recycled materials used in production
Productivity	Resource input/output ratio
	Labour productivity
Intensity	GHG emissions per unit of GDP
	Water consumed per unit of output
	Toxins emitted per unit of output/GDP
	Resources required to produce one unit of output
	Energy consumed per unit of output

Corporate Responsibility Indicators	
Environmental Stewardship	
Area of concern	**Example of indicator**
Environmental programs	Performance relative to industry standard
	Performance relative to regulatory guidelines
	Employee and consumer programs
	Investment in R&D
	Environmental monitoring and follow up records
	Environmental performance records
	Expenditures on upgrading capital stock
	Green supply chain management
Reporting efforts	Public commitment to EMS and goals
	Voluntary reporting
Philanthropy	Expenditure on non-business related environmental initiatives

Government Policy Indicators	
Policy Structure	
Area of concern	**Example of indicator**
Structure	Regulatory program in place
	Subsidies, taxes, tariffs in place
	Policies at national level
	Policies at provincial level
	Area and number of environmentally protected areas
Regulatory Effectiveness	
Area of concern	**Example of indicator**
Stringency	Allowable level of contaminants/toxins/emissions
	Regulatory applications submitted/permits issued
Effectiveness	Number of infarctions recorded
	Money collected from violations
	Regulatory authority

Appendix 3: Case Study Criteria

Evaluation Criteria For Case Studies			
Ranking			
Statement	**Modest**	**Moderate**	**High**
Environmental considerations are increasingly embedded into corporate decision making.	Compliance based approach.	Minimal + Industry has comprehensive approach to identification of key environmental impacts and developed has policies and procedures to manage impacts.	Moderate + Industry has developed sector specific standards/certifications; reports performance at a company level and via industry benchmarking.
Improving environmental efficiency frequently results in cost advantages.	Environmental performance enhancements offer no/limited cost advantage.	Environmental performance enhancements offer moderate cost advantages achievable in the short term (1-3) years.	Environmental performance enhancements offer cost advantages achievable in the short term (1-3) years and lead to business process transformation that alters costing models.
Incentives to reduce environmental impact can be a strong driver of innovation.	Low R&D spend on environmental improvements.	R&D spend on environmental improvements is a significant component of total R&D spending.	Environmental R&D drives industry innovation.
Corporate responsibility is a driver for improving environmental performance.	Voluntary/CSR initiatives are not a competitive driver of environmental performance.	Voluntary/CSR initiatives contribute to brand/product differentiation.	Voluntary/CSR initiatives drive brand/product differentiation.