Assessing the Full Cost of Energy in Nova Scotia: A GPI Atlantic Approach

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Abstract

The extraction, production, transportation, marketing and use of energy have effects on peoples' health, the environment, and society. Few of these effects are reflected in the market price of energy. The GPIAtlantic Energy Accounts identified and attempted to measure the sustainability and full cost of the current energy system based on "full-cost accounting" principles. Twenty-nine indicators covering socio-economic, health and environment, and institutional considerations were presented in the full report. This paper represents a summary of this study, focusing on the full cost analysis of energy in Nova Scotia. Only air emissions and greenhouse gases had all the data required to conduct a full cost analysis. The analysis of the damage costs associated with Nova Scotia's energy sector in 2000 resulted in a low estimate of over $ 444 million, and a high estimate of almost $4 billion. These aggregate cost estimates represent only a small fraction of the true costs of energy as these do not include cost impacts associated with energy affordability, reliability, security, resource costs, subsidies, land use, and land and water contamination. Despite the exclusions, limitations and difficulties of costing exercises, the very act of considering the full costs of energy is extremely important. The endeavour of attempting to estimate the costs of goods and services allows the consideration of costs that are outside of our traditional accounting system, and therefore not reflected in decision-making. The information presented here can be used by Nova Scotia (and others) to actively pursue a more sustainable energy sector.

Introduction

As a society we currently measure our progress primarily according to economic rates of growth. If the gross domestic product (GDP—the sum total value of all goods and services exchanged for money)[1] is growing at an ever-increasing rate, we describe the economy as "robust," "dynamic," and "healthy" (Statistics Canada, 2003). This, we assume, translates into social wellbeing and prosperity. This assumption guides our policy decisions and even determines what issues make it onto the policy agenda. What we fail to acknowledge is that the faster our current (fossil-fuel based) economy grows, the more rapidly we may be depleting our

[1] According to Statistics Canada (2003): "Gross domestic product (GDP) is a popular indicator used to estimate the value of economic activity. GDP measures two things at once over a given period of time: the total income of everyone in the economy and the total expenditure on the economy's output of goods and services produced within the country."

non-renewable natural resources, and the more air pollutants we may be emitting. Because we assign no value to our natural capital we mistakenly count its depreciation as economic gain, with no regard to the reduced flow of services that may result in the future.

To address the shortcomings of the current economic valuation system, GPI*Atlantic* is constructing an index of sustainable development, the Genuine Progress Index (GPI) for the province of Nova Scotia, which is designed to provide a more accurate picture of our wellbeing as a society. Unlike the GDP, which values only human-made capital, the GPI also values natural, social, and human capital. Unlike conventional assessment tools that are not capable of factoring long-term social and environmental impacts into the cost-benefit equation, the GPI is based on "full-cost accounting" principles that are essential to promote optimal economic efficiency. The research requires the identification of indicators of sustainability, followed by a full cost analysis. This paper represents a summary of GPI*Atlantic*'s most recent work, which identified and assessed the full costs of energy in Nova Scotia.

The extraction, production, transportation, marketing, and use of energy have effects on peoples' health, the environment, and society. Few of these effects are reflected in the market price of energy. For instance, air pollution from the burning of fossil fuels and wood has measurable impacts on people's health, which result in higher health care costs. The production of energy also has positive social benefits in that it creates jobs and economic wealth. While these benefits are more aptly reflected and monitored in the market economy, a better understanding of the full costs and benefits of competing energy choices is needed to help move society towards a more sustainable energy future.

The GPI*Atlantic* Energy Accounts identified and attempted to measure the sustainability of the current energy system through a series of sustainability indicators. The full report presented twenty-nine indicators covering socio-economic, health and environment, and institutional considerations (Lipp, et al, 2005). Of the twenty-nine indicators only air emissions and greenhouse gases had full data available that allowed for a full cost analysis. Others, for which the data limitations prevented a full analysis, are discussed but not assessed quantitatively. These include energy affordability, reliability, security, resource costs, subsidies, land use, and land and water contamination.

Estimating the Monetary Value of Externalities

Air pollution and GHG emissions are 'externalities'. An externality is defined as the effects of a market transaction on individuals or firms other than those involved in the transaction (Monette and Colman,

2004).[2] Environmental or "full-cost" accounting attempts to provide a more accurate and comprehensive picture of the full or true benefits and costs of economic activity by giving explicit value to externalities. Estimating monetary values for externalities is not an exact science because money is a poor tool for valuing goods and services that are not regularly traded in the market economy. Valuation results often depend on the judgment and the assumptions of the analyst. As a result, there are several methods for estimating the monetary value of environmental externalities. The two main methods are those that focus on the damage caused by the externality, or the cost of controlling the substance that results in the negative impacts. This paper focuses on the damage costs, as these represent the actual price that is paid by society, rather than the cost of actions or technology that would limit or control the externality.

Estimating Damage Costs

Damage cost calculations are based on the cost of the damage that the externality causes to society and the environment. This method involves the monetization of various social effects (visibility, human health, land use, agriculture, etc.). Once monetized and linked to initial pollutant loading or action, policy makers can address these externalities effectively. It must be understood that the actual emitting of a pollutant is not necessarily an expensive or costly action; rather the costs emerge from the resulting impacts. Monitoring and calculating the damage costs of the ultimate impacts in each situation (e.g. tracking each tonne of sulphur dioxide emitted from a source to the exact location where the acidic deposition occurs and measuring the effect on plants and aquatic life), though preferable, is nearly scientifically impossible and would be extremely expensive. Therefore, GPI utilizes studies that have linked ultimate damages with the initial actions.

The method used in this study is referred to as environmental value transfer. This term refers to the use of estimated valuations from one study location and applying them to another, in this case, for the province of Nova Scotia (Brouwer & Spaninks, 1999). Through the use of other more costly and direct research, general comparisons can be made

[2] Externalities can be both positive and negative. Negative externalities include water and air pollution for example. Positive externalities in the area of energy may include the sequestration of carbon by biomass crops, or the improvement of agricultural yields due to nitrogen deposition. One externality can sometimes be either positive or negative depending on the situation or degree. For example, nitrogen that has been converted in the atmosphere to an acidic form will fall as acid rain on crops thereby decreasing productivity.

to other regions outside of the initial study area. While this field of study is not without controversy, it is often pursued due to the overall cost effectiveness (Brouwer, 2000).

This paper presents both a low and high estimate in order to better represent the often-significant variability of the cost estimates in the literature. The substantial gap between the high and low estimates also reflects the different assumptions made in each of the studies.[3]

In light of these caveats, we may conclude that estimating the damage costs of air pollution and GHG emissions can be a highly useful tool, provided it is used with proper caution. It is unreasonable to assume that we can place a precise dollar value on everything, and economic valuation exercises cannot be judged by that standard.

Although much has been written on this topic, the methodologies are still developing, as this is such a young, complex, and contentious field of study. Moreover, costs will vary from place to place because there are many national and regional variations that affect any cost estimate. Despite the uncertainties, this is an important exercise since not assigning a value to non-market good and services implies they have zero monetary worth. "Whatever value one may choose to assign natural capital, zero is surely the wrong answer" (Hawken et al., 1999).

Dollar value estimates are developed for air pollution and GHG emissions in Nova Scotia for 2000. The year 2000 was selected, as it is the most recent year in which air and GHG emission data are available. Unless otherwise specified, all comparative monetary values in this report are in Canadian constant 2000 dollars (2000 CND).[4]

Calculating Externalities with Dollar Cost Estimates

Air Pollutants

The damage cost estimates for air pollutants most often include health care expenditures, as well as the costs associated with general environmental degradation (e.g., reduced crop yields, forest defoliation, acidification of lakes etc.). Varied assumptions based on these primary factors as well as the general characteristics of the valuation study help to

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[3] For a full discussion and analysis of the assumptions that were used to formulate each of the cost estimates see Monette and Colman, 2004.

[4] Conversion values were calculated using the Bank of Canada's DataBANK Statistics Look-up, which provides an historical record of inflation as well as foreign currency conversion rates. Values given in foreign currencies were first converted to Canadian dollars and then adjusted for inflation. For inflation rates see: www.bankofcanada.ca/en/inflation_calc.htm. For currency conversions see: www.bankofcanada.ca/en/exchange-avg.htm and www.x-rates.com.

explain the often wide ranging cost estimates found in the literature. With the exception of mercury, the cost estimates used in this article are taken from the previous work conducted by GPI*Atlantic* in *The Ambient Air Quality Accounts for the Nova Scotia Genuine Progress Index* (Monette and Colman, 2004).

Table 1. Nova Scotia Energy Air Pollutant Cost Estimate, 2000

Pollutant	Emissions (tonnes)	Low Estimate ($C2000/tonne)	Damage Costs	High Estimate ($C2000/tonne)	Damage Costs
CO	52,782	$2	$105,564	$6	$316,692
TPM	14,467	$2,120	$30,670,040	$5,180	$74,939,060
Sox	146,621	$1,380	$202,336,980	$10,500	$1,539,520,500
NOx	30,547	$1,410	$43,071,270	$12,450	$380,310,150
VOCs	11,474	$2,000	$22,948,000	$8,240	$94,545,760
Hg	0.267	$8,180,421	$2,184,172	$11,521,511	$3,076,243
Total			$301,316,026		$2,092,708,405

Source: (Emissions) Environment Canada, 2005. (Estimates) CO, TPM, SOx, NOx, and VOCs from Monette and Colman, 2004. Low mercury estimate from Nolan-ITU et al., 2001. High mercury estimate from Tellus Institute, 1992.

Note: Dollar value adjustments for damage costs taken from the Air Quality Accounts were adjusted for inflation and foreign currencies (Monette and Colman, 2004:151).

Estimates for carbon monoxide (CO), total particulate matter (TPM), sulphur oxides (SOx), nitrogen oxides (NOx), volatile organic compounds (VOCs), and mercury (Hg) are provided in Table 1. High and low estimates are presented and are multiplied by the emissions of the various pollutants. The emissions represent the tonnes of energy emissions for Nova Scotia in 2000 (excludes emissions from transportation and oil and gas refineries).[5] This analysis shows that a low estimate of the cost of the emissions in Nova Scotia for one year could be just over $300 thousand, while a high estimate would be just over $2 billion.

It should be noted that the cost estimates do no represent or include the damage costs associated with air pollutants generated from the non-energy sector within the province.[6] Emissions generated outside of Nova Scotia that impact the air quality in the province are also not represented. The inclusion of these emissions would significantly increase the cost estimates. The other consideration is that the emissions produced in the

[5] The emissions from oil and gas production cannot solely be attributed to the energy sector because a large portion of the fuel is used for transportation.
[6] This also excludes transportation emissions.

province may impact other jurisdictions, and those costs would not be incurred directly by Nova Scotia.

Greenhouse Gas Emissions

The case of greenhouse gas emissions typifies the complexities of full cost accounting. Though produced locally, these emissions have global impacts. Additionally, emissions released today will have uncertain effects that reach well into the future. These elements combine to make the establishment of a single dollar value a significant challenge—but not an impossible one. Despite the difficulties, this is an important endeavour due to the fact that the inherent and unseen costs associated with greenhouse gas emissions have been largely neglected.

When calculating the damage costs associated with the release of greenhouse gases, a wide array of subjects must be considered and understood. The assessment of the future impacts of climate change must consider the effects on ecological and terrestrial systems; society; agriculture; coastlines; human adaptation; global weather systems; human health and disease; and the vulnerability of people in different countries and regions. Furthermore, there are assumptions and predictions of future emissions levels and of the resulting environmental, social and economic impacts; the estimated costs of the impacts; the overall timeline selected; the valuation of money; and who is presumed to take responsibility for the emissions. It is the assumptions regarding these areas that create damage cost estimates for greenhouse gas emissions. Subtle alterations to any one of these facets can change the outcome of the cost estimate.

The estimates used here are based on the comprehensive research and analysis of 28 independent studies covering 103 estimates of the marginal damage cost for carbon dioxide (Tol, 2004). This extensive study of the literature demonstrates the wide range of the damage cost estimates per tonne of carbon dioxide (ranging from less than zero to the highest estimate of $2,472.48 - 2000 CDN).[7] The primary conclusion from this research was that the damage costs of carbon are unlikely to exceed a value of $74.17 per tonne (2000 CDN), and are very likely to be significantly lower (Tol, 2004).[8]

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[7] Based on converting the highest estimate of $1666.70 (1995 US) to 2000 Canadian dollars.

[8] Based on the conversion of the $50 (1995 US) estimate that represents the mean of all of the peer-reviewed studies as highlighted in the author's concluding remarks.

The low estimate for the marginal damage cost of carbon determined to be the most representative was $10.38 (2000 CDN). This number was chosen as it is the median of all of the estimates that used a "pure rate of time preference" (discount rate) of three percent. This number corresponds to a "social rate of discount of 4-5 percent, close to what most western governments use for most long term investments" (Tol, 2004:2073).[9]

The high range determined for the marginal damage cost for carbon dioxide was $137.96 (2000 CDN). This number was selected as it represents the mean of the entire 103 cost estimates reviewed in the study.[10] The selection of an estimate above the upper limit identified in the study was done for two reasons. First, the recognition of the precautionary principle demands that a higher estimate for the marginal damage costs of greenhouse gas emissions be included. Higher damage cost estimates are generally the result of more pessimistic forecasts of the consequences of climate change. This means that consideration is given to the possibility of extreme damage scenarios, and impacts that would be permanent or irreversible. Secondly, a higher estimate was included due to the fact that it was noted that peer-reviewed studies provided the most conservative cost estimates. Tol (2005) suggested that the peer-reviewed articles used more rigorous methods and the results were thus more certain. However, the referees of the journals may have influenced these results. It was noted that referees might be unwilling to publish any of the cost estimates that are outside of the area considered to be the general consensus.[11]

The results of the full cost accounting methods are shown in Table 2. Both the high and low marginal cost estimates are combined with the

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[9] Discounting is a process that allows total social costs and benefits in different years to be converted to a common measurement so that they can be properly compared to one another based on the assumption that a dollar now is worth more to people than a dollar received in the future. The question of discount rates is controversial and depends on how the future is valued by decision-makers in the present. The discount rate is effectively an expression of society's willingness to trade the future for the present and it can have an enormous impact on the outcome of economic valuation studies, particularly those with a long time range (50 years or longer).

[10] The mean reflects both the highest and lowest of all of the estimates, and does not distinguish based on the varied assumptions. This decision was taken as it was thought to be important to adequately reflect the broader range of estimates found within the literature.

tonnes of greenhouse gas emissions generated from the Nova Scotia energy sector. The resulting cost for the low estimate is almost $143 million, and the high estimate is roughly $1.8 billion dollars (2000 CDN).

Table 2. Total Damage Cost Estimates of the Greenhouse Gas Emissions from the Nova Scotia Energy Sector, 2000

	Low	High
Cost Estimates (per tonne)	$10.38	$137.96
Emissions (tones CO2 eq.)	13750000	13750000
Total	$142,725,000	$1,896,950,000

Discussion of Externalities With-Out Dollar Cost Estimates

Assigning dollar values to other energy externalities has received less attention but also requires study as air emissions and greenhouse gases are only some of the consequences of our current energy choices. In this section we explore other costs of the Nova Scotia energy sector without assigning dollar values – time, resource and data constraints prevented the project from carrying out full cost assessments for these other areas of concern.

Affordability

When the cost of energy exceeds the ability of people to pay for it, a number of social problems ensue. For instance, having to make choices over competing household necessities, like food, rent, clothing, or heat, causes great insecurities about how to make ends meet. More directly, fuel poverty causes people to live in cold conditions that in turn often lead to dampness and associated increases in mold. There are also the direct and measurable costs of fires and deaths due to makeshift heating in fuel-poor homes.

Fuel poverty has been researched extensively in the United Kingdom, a country that has high fuel-poverty levels. The annual cost to the national health system of treating cold-related illnesses was estimated at around £1 billion in the early 1990s (Boardman, 1991 in Friends of the Earth Scotland, 2000). This is considered an underestimate as it excludes treatment for asthma, other allergic conditions and decreased productivity, decreased mental health, and increased deterioration of buildings due to mold and rot. However, it does include the costs of illness due to cold conditions outside the home (e.g. waiting for buses). The UK has the highest incidence of fuel poverty in Europe due to its poor housing stock. Since many people live in sub-standard housing in Nova Scotia as well, the health costs stemming from fuel poverty could

potentially be in the millions of dollars for this province. These costs, however, could not be quantified since there is no systematic collection of data about fuel poverty and its impacts in Nova Scotia.

Reliability

The issues and costs associated with the reliability of energy in Nova Scotia is an extremely relevant topic given the significant weather events (e.g. Hurricane Juan, White Juan, November '04 ice storm) that have interrupted power in the province. When power outages and shortages occur, they not only disrupt the activities of individuals, homes and businesses, but they may impede people's ability to meet basic needs. Events related to outages include carbon monoxide poisoning caused by the operation of gas generators; house fires started by electrical devices coming back on after power is restored; and even car accidents caused by traffic lights that are not operating (Lipscombe, 2004; Nicoll, 2004).

A published survey by the Canadian Federation of Independent Businesses demonstrates the impacts and costs facing businesses operating in Nova Scotia. In a survey that included more than 500 small business owners, forty percent indicated that their business had been interrupted by more than three power outages in 2004 (Hache, 2005). The impacts caused by these outages included employees not being able to work, lost orders or customer traffic, lost production of goods or services, lost revenue due to lack of electronic payment capabilities, increased cost due to outages, and damaged, spoiled or lost inventory.

This is a clear demonstration of the complexities of the economic, social, and environmental costs associated with the reliability of energy. While the establishment of a full cost estimate is not currently possible, the issue of electricity reliability is one that requires consideration when conducting a full cost assessment of the energy sector in Nova Scotia.

Energy Security

Energy security and energy reliability are closely linked as a result of the current market structure. The reality of the global energy market means that anyone purchasing oil will likely have benefited from, or paid a lower price, due to the military efforts and expenditures related to the global effort to secure fossil fuels (Levin, 2003). The most prominent examples of energy security costs are the military expenditures of the United States. The largest expenditures are those related to the two major conflicts in the Middle East. The Gulf War in 1991 carried a net cost of $7 billion dollars (2000 US) (Lovins, 2003). The Iraq War that began in 2003 has been estimated to have an ongoing cost between $150 and 300 billion dollars (2003 US) (ICTA, 2005). Even the peacetime costs spent on the

military forces prepared for interventions in the Persian Gulf are approximately $60 billion dollars a year (2000 US).

Other areas of the world, particularly South America, are also becoming areas of military involvement as a result of energy resources. Columbia, Venezuela and Ecuador supply about 20 percent of US oil imports and Columbia is now the third largest recipient of U.S. military aid (behind Israel and Egypt). Many analysts believe that a portion of these expenditures is for securing energy pipelines, and not just efforts to control the narcotics trade (ICTA, 2005). These examples are all based on American military expenditures. The reality is that the security of energy is a global pursuit. One estimate suggests that approximately 25 percent of the entire world's military budget goes to securing oil (ICTA, 2005). While it would be extremely difficult to calculate the associated costs or benefits that could be linked to Nova Scotia, it would be misleading to exclude these costs outright. There are also costs beyond the direct financial expenditures that should be considered such as the considerable human, environmental, and social costs that are incurred while attempting to provide global energy security.

Resource Costs

There are intrinsic and external costs associated with the exploration, extraction and processing of energy resources that occur in Nova Scotia and in other locations that provide energy resources. The current global structure of the energy system ensures that countries, while geographically separate, are inextricably linked. For example, the importing of coal to Nova Scotia means that many of the environmental and human health effects due to our consumption of coal for electricity occurs elsewhere. For instance, human rights violations have been reported by workers and union leaders in the coal mining districts of Columbia, a major supplier to Nova Scotia (ARSN, 2005). Mining accidents and illness are common occurrences in the mining industry; frequently resulting in poor health for mine workers and even premature death. Placing a value on the cost of human life is an area of on-going research for which there is unlikely ever to be consensus, but again, not assigning any value to human life is equally problematic and under-represents the cost of our energy choices.

Resource Depletion

Separate, but related to the issue of consumption is the topic of resource depletion. Depletion can be defined as the "progressive reduction of the overall stock (or volume in the instance of oil and natural gas) of a resource over time as the resource is produced" (EIA, 2000: ix).

A study conducted by the New South Wales Environmental Protection Authority (1998) attempted to establish a cost estimate for coal that included the costs associated with resource depletion. The cost estimate also reflected the more common environmental costs associated with the mining and extraction of coal. This study considered the cost of rehabilitating land, as well as the use of extensive predictions regarding the future demand for coal as well as the technologies that might be in use in the coming years. The analysis resulted in the establishment of an estimate of $26 (1997 US) per tonne.

A study conducted by the Energy Information Administration (2000) identified some of the impacts and relationships that are apparent in scenarios involving accelerated resource depletion. For example, higher oil prices caused by resource depletion would result in higher natural gas prices and lead to increased exploration and production activities for gas resources (EIA, 2000). The analysis also shows that the accelerated depletion of oil and gas would likely result in a greater dependence on coal in the U.S. (EIA, 2000). Substantial discrepancies between energy production and demand will cause widespread economic hardship and fundamental restructuring of economies.

Energy Subsidies

Subsidies are another important, but often-ignored cost that is associated with energy. More often than not, energy subsidies are ongoing expenses that are paid for with public tax dollars. Energy subsidies can result in market distortions, and prevent the general public from paying the direct or full cost of energy.

Subsidies can provide benefits to some while negatively impacting others. In other cases, the subsidies can be considered perverse, because they have a negative impact on both the economy and the environment (Myers & Kent, 1998). Despite these complexities, energy subsidies are used extensively worldwide (Pershing and Mackenzie, 2004).

In Canada, the oil and gas industry is heavily subsidised. This was demonstrated in a study commissioned by the Climate Action Network conducted by The Pembina Institute which showed total subsidy expenditures between 1996 and 2002 exceeded $8.3 billion (2000 CDN) (Taylor et al., 2005).

The exact portion of this government subsidy that benefits the energy sector in Nova Scotia is not known. Despite the exclusion of these numbers, the Canadian oil and gas subsidy example shows that if these were considered in the full costs, the end result would be significantly altered.

Land Use Costs

The land use costs associated with the energy system is another important consideration that in some cases are already included in the price of energy in a competitive market structure. For example, most utility companies need to purchase land before building plants. Similarly, wind energy requires land to be purchased or leased. These costs get transferred through to the user. However, there are cases where property taxes or purchasing prices do not accurately reflect land use costs.

Possibly the most significant externality of energy land use is that life-sustaining services provided by undeveloped land are reduced or eliminated. For example, there is no market value for trees purifying the air and replenishing oxygen and wetlands that purify water and limit flooding. Methods for costing these types of non-market services might include the cost of purifying water in a plant or purifying air through a filtration system. One landmark study that relates to this type of cost estimate is the work conducted by Costanza et al. (1997).[12] There it was estimated that the value of ecosystem services in boreal and temperate forests is at least $460.97/ha/yr (2000 CDN) ($302/ha/yr - 1994 US).

It should be recognized that different energy sources have different degrees of impact on ecosystems. For example, an industrial power plant provides no ecosystem services whereas a high yield plantation for bio-energy would still provide ecosystem services though at a reduced level compared to a natural forest. At this point we can only state that the inclusion of land use costs would affect the results of a full cost accounting exercise, mostly likely increasing the costs of energy.

Land and Water Contamination

Contamination of land and water is another cost resulting from our energy system. Impacts include the discharge of high temperature water from thermal power plants, to the tailings that result from mining coal. Perhaps the most relevant issue to Nova Scotia relates to the contamination of land and water through oil spills. The rough estimates provided by the Department of Environment and Labour reported 470 oil spills in Nova Scotia for 2002, and 350 spills in 2003 (Baxter, 2004).

An analysis of Halifax newspapers over a six-year period (between 1999 and 2004) showed that there were 19 spills that resulted in the release of 8,882 litres of oil (Lipp et al., 2005). The total economic cost associated with these 19 spills was $865,000. This cost included fines, clean-up costs, compensation, and corporate donations related to the

[12] For further information on the valuation of the goods and services provided by the natural environment see Costanza et al. (1997) and de Groot, et al. (2002).

spills. It does not include or reflect the environmental or social damage that could be attributed to these events.

The 19 incidents represent only a fraction of the oil spills that occurred in the province of Nova Scotia in the last six years, and do not include smaller scale spills such as those from home oil tanks. The insurance industry notes that the costs associated with domestic oil spills are now the third most expensive insurance claim in Atlantic Canada, with only fire and water damage being higher (Harris, 2005). Between 1999 and 2002, New Brunswick, PEI, Newfoundland and Nova Scotia had 1,239 claims related to domestic oil spills that cost insurance companies $61.4 million dollars (Harris, 2005).

Aggregated Damage Cost Estimates for Nova Scotia's Energy Sector

The aggregated damage costs, including GHG emissions and air pollutants for the year 2000, are shown in Table 3. High and low estimates are also included as well as costs per capita based on a population of 933,881.[13]

Table 3. Aggregated Damage Cost Estimates for Nova Scotia's Energy Sector

	Low	High
Air Pollutant Damage Costs	$301,316,026	$2,092,708,405
GHG Damage Costs	$142,725,000	$1,896,950,000
Total	$444,041,026	$3,989,658,405
Per Capita	$475	$4,272

The energy sector alone accounts for $444 million to almost $4 billion in externalities each year for air and greenhouse gas emission impacts. At a minimum, these costs equal over $475 for every woman, man, and child in the province. It should be reiterated that these costs are not incurred only in Nova Scotia but are experienced regionally in the case of air pollution, and globally in the case of GHGs.

The totals presented in do not include a wide range of costs including reliability, security, subsidies, land use, and contamination (or transportation energy use). If included, the full cost of energy would increase significantly. Likewise it must be remembered that these 'estimates' are exactly that, estimates. They do not include a variety of social, environmental, and economic costs. Methodologies continue to improve. New knowledge as to effects and costs will be realized.

[13] From Statistics Canada CANSIM Table 051-0001

Therefore, these estimates highlight the extent of the damage, and not the precise dollar amount.

Summary

The practice of full cost accounting can be both contentious, and incomplete. Selecting the most applicable cost estimate to represent values in another location can be difficult, and the availability of the data is often limited. This is exemplified by the fact that the costs associated with air pollutants and greenhouse gases were the only two areas that were fully valuated. The majority of the costs were only discussed in general, using examples to highlight the costs where possible.

The assessment of air pollutants and greenhouse gas emissions resulted in a low estimate for the aggregate damage costs associated with Nova Scotia's energy sector in 2000 of over $444 million, while the high estimate was almost $4 billion. These aggregate cost estimates represent only a small fraction of the true costs of energy. As noted, these estimates do not include a wide range of costs that were discussed above. The inclusion of these costs would significantly increase the overall estimate of the total costs of energy in the province.

Despite the above listed exclusions, limitations and difficulties, the very act of considering the full costs of energy is extremely important. This exercise of outlining and recognising the true costs associated with energy use can help inform and improve policy making within the province. The awareness that investments in specific energy industries and technologies might result in increased environmental and health costs should help to guide decision-making. This information allows for a more informed and sustainable approach to addressing assessments in the energy sector. Furthermore, this will help to expand the general knowledge and recognition that our energy system here in Nova Scotia has costs and impacts that extend well beyond our borders.

The endeavour of attempting to estimate the costs of goods and services allows the consideration of costs that are outside of our traditional accounting system, and therefore not reflected in decision-making. The information presented here can be used by Nova Scotia (and others) to actively pursue a more sustainable energy sector.

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