EXECUTIVE SUMMARY

The GPI Greenhouse Gas Accounts are primarily an educational tool. This report first identifies key concepts, principles, assumptions, evidence and uncertainties in the climate change debate (Chapters 1 and 2 and Appendix B). The report then goes on to examine potential impacts of climate change in Atlantic Canada (Chapter 3). Details are given of Nova Scotia's greenhouse gas (GHG) emissions and their estimated costs to global society as well as the estimated costs of reducing GHG emissions (Chapters 4 and 5). Opportunities for reduction of emissions are outlined briefly, along with a general overview of the potential costs and benefits of these measures and some recommendations for future action and study (Chapters 6, 7 and 8). Appendix A places this study in the context of the Nova Scotia Genuine Progress Index (GPI) as a whole. Appendix B provides a detailed explanation of the science of climate change. Appendix C relates this study to the current development of an energy strategy for Nova Scotia. Appendix D presents a detailed case study of costs and benefits of reducing GHG emissions in the Nova Scotia Freight Transportation Sector and thereby demonstrates the utility and applicability of GPI full-cost accounting methods to specific emission reduction scenarios. The GPI Greenhouse Gas Accounts are one of 22 components of the Nova Scotia GPI, a measure of sustainable development being constructed as a pilot project for Canada. Current measures of progress based on the gross domestic product (GDP) misleadingly count many adverse circumstances as contributions to prosperity and well-being simply because they fuel economic growth and spending. Increased fossil fuel combustion and GHG emissions along with crime, pollution, sickness, natural disasters and natural resource depletion all contribute to the GDP and to the economic growth statistics. By contrast, the GPI recognizes such activities as costs rather than gains to the economy. Unlike measures of progress based on the GDP, in which "more" is always "better," less is frequently better in the GPI and so a reduction in GHG emissions signifies genuine progress. From the GPI perspective, money saved by reduced spending on prisons, pollution clean-up, disaster costs, cigarettes, sickness costs, and fossil fuel combustion, can be invested in more welfare-enhancing activities that can contribute to more desirable forms of economic development. Appendix A explains the principles, purposes and methods of the GPI in more detail.

Questions such as whether observed global warming is the result of increasing emissions of GHGs may never be definitively answered because simple cause and effect can rarely be proved, even with the best science. The more appropriate question to ask is, "What is the likelihood that the warming is related to increased GHG emissions?" Because of the high correlation of GHG emissions with increasing global temperatures and because the science of GHGs tells us that they are indeed capable of trapping heat within the earth's atmosphere, the International Panel on Climate Change (IPCC) concluded in 2001 that: "In the light of new evidence and taking into account remaining uncertainties, most of the observed warming over the last 50 years is likely (66-90% chance) to have been due to increase in greenhouse gas concentrations." Based on a review of the scientific evidence (Appendix B) and the internationally accepted precautionary principle, as well as recent statements by the IPCC, Chapter 2 of this study accepts that the evidence is too great and the potential impacts too severe to ignore that climate change is significant and is likely linked to human activities.

The chief impacts of climate change that are expected in Atlantic Canada include sea level rise, drought, increase in extreme weather events and changes in rainfall, all of which can have an adverse impact on our social infrastructure, tourism, fisheries, forestry, agriculture, ecosystems and water resources (Chapter 3).

Total GHG emissions for Nova Scotia in 1997 were 20 million tonnes, an increase of 3% over the 1990 amount of 19.4 million tonnes. Emissions are projected to increase through 2015 and then to decline due to conversion of oil and coal fuelled facilities to natural gas. Even with conversion to natural gas, Nova Scotia's (and Canada's) per capita emissions are among the highest in the world and about twice the West European average.

Chapter 4 identifies the major sources of GHG emissions as being related to fossil fuel use for energy (92%). Generation of electricity accounts for 39%; transportation for 27%; and residential energy use for 11% of total emissions.* Globally, 25-30% of total human-caused carbon emissions are the result of

deforestation and land use change, but this study has not been able to ascertain comparable estimates for Nova Scotia.

Chapter 4 concludes that reasonable initial targets for reduction of GHG emissions in Nova Scotia include a low target (Kyoto accord) of 2.9 million tonnes between 2000 and 2010, or a higher target of 5.2 million tonnes. In the Nova Scotia GPI, movement towards and attainment of these targets is the main indicator of "genuine progress." However, since 1995, Nova Scotia's GHG emissions have increased, not decreased, indicating a decline in progress for this component of the GPI.

Estimates of the global climate change damage costs likely to result from Nova Scotia's GHG emissions, as well as the gross costs of reducing these emissions are derived by simply multiplying Nova Scotia's annual emissions by per tonne estimates of damage costs and control costs cited in the literature by climate change researchers. Based on these estimates, Nova Scotia's 1997 GHG emissions alone will cause between $760 million and $21 billion worth of global damages due to climate change. The gross cost of reducing Nova Scotia's GHG emissions to meet the Kyoto targets is estimated at between $29 million and $348 million. The more ambitious target of a 5.2 million tonne reduction in emissions proposed by the David Suzuki Foundation will cost between $52 million and $624 million. ∗

In order to avoid double-counting, residential energy use excludes residential transportation use (counted under "transportation") as well as the emissions resulting from electricity generation. Clearly a reduction in household greenhouse gas emissions can also reduce emissions in these other sectors. These gross damage and control costs do not include the health and other co-benefits of cleaner air and exclude other co-benefits of reducing GHG emissions. In actual fact, GHG emission reductions can produce a wide range of concomitant savings and benefits.

Policy makers generally consider only one part of the cost equation – the direct investment required to reduce GHG emissions. When avoided damage costs and co-benefits of GHG reductions are included in the equation, as they must be, the mitigation investment is found to be highly cost-effective. Using gross control cost estimates, avoided primary and secondary damage cost estimates, and a limited range of co-benefits, the net benefit of meeting the Kyoto reduction target of 2.9 million tonnes would be $469 million to $10.4 billion (C$1997) over the period 2000-2010. The net benefit of meeting a 5.2 million tonne reduction target would be $840 million to $18.6 billion (C$1997) over the period 2000-2010.

Chapter 5 examines the assumptions of various cost estimates in detail and offers an interpretation of the potential enormity of damage cost estimates. Acceptance of the precautionary principle described in Chapter 1 requires that the higher range of damage costs be used in the GPI and therefore leads to the conclusion that investments in reducing GHG emissions are highly cost-effective. Estimated over 10 years there is likely to be an average global return of $31 in avoided damage costs for every $1 invested, even when a range of co-benefits is not included. Chapter 5 indicates that in the year 2010, using low estimates of both control and damage costs from the literature, every $1 invested in reducing GHG emissions will produce $27 in savings due to avoided climate change damage costs. Using the high estimates from the literature, every $1 invested in reducing emissions will produce $53 in savings.

Using a ten year estimate from 2000-2010, rather than a single year snap-shot, every $1 invested in reducing GHG emissions will save $17 in avoided damages using low end estimates and $31 using high end estimates.

Even more significantly, the cost effectiveness of reducing GHG emissions is shown in Chapter 5 not to be dependent on the differing assumptions of the climate change economists who have calculated both the high and low end damage and control costs as well as intermediate estimates. Even using optimistic (low) estimates of potential climate change damage costs and pessimistic (high) estimates of control costs, the savings from avoided damages exceed the cost of reducing GHG emissions.

In short, greenhouse gas emission reductions are cost effective at any price when compared to potential climate change damage costs – using any range of estimates in the accepted literature.

The GPIAtlantic freight transportation study (Appendix D) has produced a GHG Mitigation Index (GMI), which does include a wider range of concomitant benefits and costs than most conventional estimates, and thus provides a far more accurate and comprehensive assessment of the net cost or benefit to society of particular GHG reduction measures. For emission reduction strategies in the transportation sector, the GMI includes GHG emissions, air pollution, accidents, administration, policing, capital and a range of other costs. For the freight transportation study, the GMI was -$715 per tonne of GHG emissions reduced, indicating a net benefit to society of $715 for every tonne of GHG emission reduction. That case study concluded that a 10% shift of GENUINE PROGRESS INDEX v Measuring Sustainable Development freight from truck to rail would result in a net benefit to society of more than $10 million per year. Opportunities for reduction of GHG emissions in electricity generation, land transportation and residential energy use are examined in Chapter 6 to identify other actions that could also potentially produce net benefits to society when a full range of economic, social and environmental costs and benefits are included in the analysis. These "no regrets" measures could result in GHG emission reductions of between 2.9 million and 4 million tonnes, with estimated net benefits of between $142 million and $4.4 billion annually. More detailed analyses, along the lines of the freight study, are necessary to determine which of the actions outlined in Chapter 6 are the most cost-effective. These emission reductions and savings refer only to the three sectors (electricity generation, land transportation and residential energy use) that account for 70% of total GHG emissions in Nova Scotia. If similar emission reductions took place in the other sectors (including air transport, manufacturing, agriculture, waste, and commercial energy use) that account for the remaining 30% of emissions, then Nova Scotia could reduce its total emissions by between 4.1 million and 5.7 million tonnes by 2010. This would exceed both the Kyoto and Suzuki targets. This study concludes that, just as Nova Scotia has become a world leader in solid waste resource management, it is reasonable for Nova Scotia also to take the lead in reducing GHG emissions and to become a model for other

jurisdictions to do so. An essential first step is to recognize that increased GHG emissions represent a potentially catastrophic cost to society rather than a gain, as current measures of progress based on the GDP imply. With that understanding, the province can set reasonable and sector-specific targets for reduction within the next six months; determine the most cost-effective ways to meet the targets; set up incentives or regulations to implement the reduction mechanisms; and create systems for monitoring progress. At the same time, the province may examine ways of adapting to the climate change that is likely already under way. Appendix C examines the relevance of GHG accounting for the current development of Nova Scotia's new energy strategy. Dr Larry Hughes of Dalhousie University concludes that a fossil fuel-based energy policy is unsustainable both because of the environmental dangers of excess GHG emissions and because such a policy no longer makes economic sense: In Appendix C, Dr. Hughes argues that the price of fossil fuel-based energy will continue to rise in step with increasing world demand. Already, the rising cost of home heating fuel is hurting many Nova Scotians on fixed incomes and the rising cost of gasoline is affecting Nova Scotian motorists and increasing the cost of shipping goods to and from Nova Scotia. According to Dr. Hughes, the most obvious way both to reduce GHG emissions and to curtail the rising costs of fossil fuel resources that will become increasingly scarce is to "decarbonize" Nova Scotia's economy. If Nova Scotians were to reduce their consumption of fossil fuels using the measures outlined in this report, not only would they be "saving money" (by using energy more efficiently), they would also be "saving the environment." GENUINE PROGRESS INDEX vi Measuring Sustainable Development Off-shore oil and natural gas will not last forever, writes Dr. Hughes, and a long-term sustainable "energy strategy" cannot be based on a short-term boom in off-shore exploration that will make these fuels temporarily more abundant. What is needed is a sustainable energy policy that will ensure the energy future for all Nova Scotians and that will: • foster the growth of a renewable energy industry in Nova Scotia by adopting a "Renewable Portfolio Standard;" • require all existing thermal stations (coal and oil) to convert to combined heat and power; • offer low-cost loans to communities that wish to take advantage of combined heat and power; • institute a provincial transportation strategy, consisting of community buses (operating in rural communities), regional buses (connecting rural communities to regional centres), and inter-city buses and trains (connecting regional centres); • shift long-distance freight transport from road to rail, and handle local distribution through local trucking firms; • re-implement the energy efficiency projects and

programs formerly operated by the provincial government; • introduce zoning laws that would require all new buildings to maximize their reliance on solar energy; and • require the Auditor-General to present an annual report on the province's progress towards a sustainable energy future. Such a policy will enable Nova Scotians to reduce their GHG emissions drastically, to become leaders in the field of sustainable energy, and to gain knowledge and expertise that could be shared with the world.