GPI Atlantic

Genuine Progress Index for Atlantic Canada / Indice de progrès véritable - Atlantique

MEASURING SUSTAINABLE DEVELOPMENT

APPLICATION OF THE GENUINE PROGRESS INDEX TO NOVA SCOTIA

THE NOVA SCOTIA ECOLOGICAL FOOTPRINT

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EXECUTIVE SUMMARY

Small Province, Big Feet: Nova Scotia's Ecological Footprint

Development that is "sustainable" requires that:

1) we do not consume more resources than the planet can provide, and that we do not produce more waste than the planet can assimilate;
2) we live in such a way that the next generation will not be worse off than we are;
3) we do not consume resources at the expense of others' basic survival and livelihood.

In other words, "sustainable development" requires that we live responsibly and with awareness, so as not to deplete our natural wealth and leave a poorer world for our children and others to inherit.

Measurements of sustainable development generally look at the "supply" side of the equation – whether we are harvesting our fish, logging our forests, and growing our food in sustainable ways. But such measurements put the whole onus for sustainable development on the producer. The "ecological footprint" looks at the "demand" side of the equation and places the responsibility for sustainable development equally on the consumer. The Nova Scotia Genuine Progress Index, a pilot project for Canada that includes 22 environmental, social and economic components, measures sustainable development in both these ways.

How we eat, shop, travel, use energy and build our houses directly impacts the environment. Almost everything we do consumes natural resources and produces waste. Our ecological footprint is the amount of space we take up, or the amount of land and sea area it takes to meet our current levels of consumption. It tells us what impact our consumption patterns have on the environment and whether we are exceeding the capacity of the environment to satisfy our wants.

The world has a limited supply of productive land for growing food and timber, limited supplies of fish, finite quantities of oil, gas, metals and other non-renewable resources, and a limited capacity to absorb waste. If we overload the earth's capacities, or use up resources faster than they can replenish themselves, then the natural systems that support life on earth break down.

Living Beyond our Means

Scientists tell us that as human beings, we can't use all the productive land that exists entirely for our own needs if we want to survive, and they suggest that at least 30% of land needs protection. World leaders have committed to set aside just 12% of our land to protect the millions of other species on the planet, on whom our survival ultimately depends. If we set aside that 12% to protect biodiversity, and divide the remaining 88% of biologically productive area by the current world population, then we have 1.8 hectares per person to supply all our human needs and assimilate all our waste.

Researchers at the University of British Columbia have found that our *current* global resource consumption and waste production requires 2.8 hectares per person. That is the *average* "ecological footprint" of a human being in the world today. In other words, human beings are in a state of "overshoot," depleting resources faster than they can regenerate and producing more waste than the world can handle.

This is like living in debt, with a gradually accumulating ecological deficit. Just as the present generation is paying for over-spending in the 1970s and 1980s with higher tuition and reduced government services, so future generations will inherit the ecological debt of current ecological overshoot. We may have already begun to see its effects in the collapse of Atlantic ground-fish stocks, global warming, higher child asthma rates, and new environmental illnesses.

But all ecological footprints are not the same size. 30% of the world's population consumes 70% of the world's resources, and produces 70% of the world's waste. The average African ecological footprint is just 1.3 ha. per person, and the average North American footprint is 11.8 ha. per person. The richest one-fifth of the world's people consumes 45% of all meat and fish, 58% of all energy and 84% of all paper, and it owns 87% of all cars. The poorest one-fifth consumes just 5% of all meat and fish, less than 4% of energy, 1.1% of paper, and less than 1% of all cars.

This GPI *Atlantic* report has found that Nova Scotia's average ecological footprint is 8.1 ha. per person, far in excess of the 1.8 ha. per person globally available. If all the world's people were to consume at Nova Scotian levels, we would need four additional planets earth to provide the necessary resources and waste assimilation capacity.

Of this 8.1 hectares, transportation accounts for 1.6 ha., food for 2.4 ha., residential energy use for 1 ha. and all other consumption for the remaining 3.1 ha. Just as global ecological footprints differ, not all Nova Scotian ecological footprints are the same size. The Halifax Regional Municipality has a footprint of 8.4 ha. per person, and the wealthiest 20% of Nova Scotians have a footprint of 10.7 ha. per person (compared to 6.2 ha. for the poorest 20%), because the wealthy consume more resources and produce more waste.

The Nova Scotia ecological footprint has grown by 40% in the last 40 years, and it is projected to increase by another 12% to 9.2 ha. per person in the next 20 years. Our transportation footprint is expected to increase by 25% as more cars log more kilometres. The rapid increase in fuel-inefficient SUV's, minivans and light trucks has expanded the transportation footprint sharply, with one SUV averaging three times the impact on the environment of a small car.

Reducing our Ecological Footprint: A Million Hectare Target for 2002

This report, Canada's first *provincial* ecological footprint analysis, concludes that Nova Scotians could quickly and easily reduce their collective ecological footprint by 1 million hectares from 8.1 ha. per person to 7 ha. per person without compromising their quality of life. Consuming less of some items, shifting certain consumption choices, and changing public policy priorities can actually improve well-being and quality of life while reducing our impact on the environment.

Suggested personal changes recommended in the GPI report include:

- Walking and riding a bicycle whenever possible.
- Carpooling or taking public transportation to work instead of driving alone.
- Driving smaller more fuel-efficient cars, and keeping them well-maintained.
- Buying more locally grown foods and locally produced goods to reduce transportation.
- Not overeating, but consuming the calories appropriate for our age and level of activity.
- Eating more grains, vegetables and natural foods.
- Reducing household energy use by turning off lights, turning down the temperature at night and when not home, hanging out the laundry to dry, and using energy efficient appliances.
- Reducing water consumption by using a water-efficient showerhead, turning off the tap when not in use, and collecting rainwater to water plants and lawns; and
- Reusing, recycling and composting trash, and reducing packaging.

Beyond such individual choices, the GPI report also points to the social and political decisions that are necessary to reduce the province's ecological footprint to *less* than 7 ha. per person, and to become a model of responsible and sustainable living. These social choices include:

- Investments in public transportation and bicycle lanes.
- Integrated land use / transportation planning to counter suburban sprawl.
- Tax incentives to support environmentally friendly Danish-style co-housing developments.
- Support for local agriculture, sustainable farming methods, and nutritional education.

Nova Scotians have already dramatically reduced their solid waste footprint by 50% in just five years, and Nova Scotia's world leadership in composting, recycling and solid waste diversion is a model of government-citizen cooperation that can show a sustainable way forward into the future. Bear River's award-winning Solar Aquatic sewage and waste water treatment system has also become a model of sustainable water use. Clearly, footprint reductions are not only possible but have already been successfully accomplished in some areas.

In the early 1980s too, Nova Scotians substantially reduced their energy footprint through switching to smaller, fuel-efficient cars, insulating their homes and other conservation measures, though the provincial energy footprint has started to creep upwards again in the 1990s. Today our total energy footprint (4.5 ha./person) is still 25% smaller than it was in 1979, but it is also 40% larger than it was in 1961. Nova Scotia today is at a crucial point in its history in developing an energy policy for the future. The innovative work of the Western Valley Development Authority in exploring wind-powered electricity generation in the Annapolis Valley could produce a model for the future that would substantially reduce the province's energy footprint

The average Nova Scotian's total ecological footprint (8.1 ha./person) is just two-thirds the size of the average American's footprint (12.2 ha./person), but it is still 30% higher than the average West European's footprint (6.3 ha./person), indicating that we might more productively look to Europe and elsewhere for workable models of sustainable development rather than to the United States. Denmark, for example, has become a world leader in wind energy; the Netherlands is actively promoting bicycle use and pesticide-free farming; BMW cars are now made with 35%

recycled parts; and Curitiba, Brazil, has become a world leader in integrated land use / transportation planning and mass transit use.

In sum, for a Nova Scotia determined to reduce its ecological footprint, there is no shortage of outstanding examples of sustainable living and development, including powerful ones within its own borders. The purpose of this *Ecological Footprint* analysis is to encourage concrete public-private steps towards a more sustainable future that we are proud to leave to our children.

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Inspiration for the Nova Scotia Genuine Progress Index came from the ground-breaking work of Redefining Progress, which produced the first GPI in the United States in 1995. Though **GPI***Atlantic*'s methods differ in many ways, particularly in not aggregating index components for a single bottom line, we share with the original GPI the attempt to build a more comprehensive and accurate measure of wellbeing than can be provided by market statistics alone. **GPI***Atlantic* also gratefully acknowledges the pioneers in the field of natural resource accounting and integrated environmental-economic accounting on whose work this study and the GPI natural resource accounts build.

Needless to say, any errors or misinterpretations, and all viewpoints expressed, are the sole responsibility of the authors and ***GPI****Atlantic.*

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1. Introduction: The Ecological Footprint and the GPI

The GPI Ecological Footprint analysis is one of the core components of the Nova Scotia Genuine Progress Index, a new measure that can provide more accurate and comprehensive information on well-being and sustainable development than current measures based on economic growth rates and related market statistics.

Conventionally, economists, politicians and journalists measure progress according to how fast the Gross Domestic Product (GDP) is growing. The GDP simply measures the total market value of goods and services produced, and the total amount of consumer spending. But measuring well-being and progress in this way sends very misleading signals to policy makers and the general public. The GDP counts the depletion of our natural resource wealth as economic gain, because it measures only the market value of our resources once they are harvested. The more fossil fuels we burn, the more trees we cut down, the more fish we sell, and the more rapidly we deplete our resources, the faster the economy will grow, which, in turn, is interpreted as a sign of well-being and progress.

The GDP also does not care *what* is growing: More crime, sickness, pollution, accidents and natural disasters all make the economy grow. And the GDP ignores anything that doesn't have a price tag – like volunteer work, unpaid household work, free time, and vital life-supporting services provided free by nature. The GDP can grow even as inequality and poverty grow. In short, the GDP and related economic growth statistics are incapable of telling us how "well off" we are, let alone whether our development is sustainable, and its architects never intended it as a measure of well-being and progress the way it is used today.

By contrast, the Genuine Progress Index attempts to account for our social, environmental *and* economic health. It's 22 components include natural resource accounts, time use variables (including the value of unpaid work and free time), and indicators of health, educational attainment, livelihood security, equity and environmental quality. It also counts liabilities like crime, pollution, greenhouse gas emissions, sickness and accidents as *costs*, rather than gains to the economy.

Unlike the GDP, which measures only current income and spending regardless of its consequences, the GPI takes a long-term perspective and assesses whether we are leaving the world a better place for our children as well as ourselves. Therefore, it is called an index of *sustainable* development because it assesses whether current production and consumption patterns can be *sustained* over time without depleting our wealth (our natural, social and produced capital) and without denying a decent standard of living to our children and to others in the world.

The *GPI Ecological Footprint* analysis is one of the most essential elements of the Genuine Progress Index, for four basic reasons:

1) It assesses the *demand* side of the sustainable development equation as well as the supply side, and places the onus for sustainability on the *consumer* as well as on the producer.
2) It challenges fundamentally the economic growth paradigm and the assumption that "more" is necessarily "better." In the GPI, a *smaller* footprint is a sign of genuine progress.
3) It links environmental sustainability clearly and directly with social justice and equity.
4) It links local consumption patterns with global consequences.

Let us briefly examine each of these functions in turn.

1) Most measures of sustainable development implicitly place the onus of change on the producer rather than the consumer. Natural resource accounts, for example, assess whether timber, fish, agricultural products and other resources are being harvested sustainably, and they may recommend more sustainable harvesting methods (e.g. selection logging, restrictions on dragnet trawling, and shifts to organic farming) which require changes in production techniques. But few measures place the onus for sustainability directly on the shoulders of the consumer. Because it addresses the *demand* side of the sustainability equation and assesses the environmental impacts of our *consumption* patterns, the ecological footprint is an essential complement to other GPI components that focus on the *supply* side of sustainable development.

2) Conventional measures of progress based on the GDP and related economic growth statistics implicitly assume that "more" is "better." The more economic activity there is, and the more money people spend, the "healthier" and more "robust" our economy is said to be, and the "better off" we are assumed to be. When sales go up, economic experts and journalists pronounce that "consumer confidence is strong." When sales go down, that confidence is said to be "weak," and the slowdown spells trouble. The language we use daily reflects the implicit assumption that "growth" equates to "health" and "well-being."

   The Genuine Progress Index challenges that core assumption directly, and contains several components in which "less" is frequently "better," and a more accurate signal of societal well-being. As noted above, more crime, more pollution, more sickness and accidents, more greenhouse gas emissions and natural disasters all make the economy grow simply because more money is being spent on prisons, police, hospitals, pollution cleanup and other regrettable expenditures. The prison industry is one of the fastest growing sectors of the US economy contributing $42 billion a year to the US GDP. Smoking and obesity contribute $300 million a year to the Nova Scotia economy in medical costs alone. And the *Exxon Valdez* contributed more to the Alaska GDP by spilling its oil than if it had delivered its oil safely to port.

By contrast, *less* crime, pollution, sickness, accidents and greenhouse gas emissions are signs of genuine progress and well-being in the GPI. This is common-sense economics, but it challenges our current reliance on economic growth statistics to assess societal well-being.

The GPI *Ecological Footprint* analysis clearly illustrates this point that "less" is sometimes "better." A sustainable ecological footprint, which is significantly *smaller* than the current ecological footprint of Nova Scotians and Canadians, is a sign of genuine progress because it indicates that we are having *less* impact on the environment and preserving the health of our natural wealth more successfully for the benefit of future generations. The large current footprint of Nova Scotians and Canadians indicates quite simply that we are living beyond our means, and that the Earth cannot indefinitely sustain our current consumption habits.
Scientists have noted that the natural world thrives on equilibrium and balance, and rests firmly on inherent *limits* to growth. The only biological organisms that thrive on unlimited growth, like cancer cells and weeds, are inherently destructive. This is an apt metaphor and warning for a human economic paradigm that remains wedded to a doctrine of limitless growth.[1]

The ecological footprint assessment is a tool devised by University of British Columbia scientists William Rees and Mathis Wackernagel to quantify the environmental impact of consumption patterns and to document the current ecological "overshoot" created by excess consumption in the industrialized world.

Although not part of the original U.S. GPI produced by *Redefining Progress* in California, an ecological footprint analysis is included in the Nova Scotia GPI as the most direct and comprehensive challenge to the industrial and economic paradigm on which current measures of well-being and progress are based.

3) The basic principle linking and integrating the components of new measures of progress and well-being is the view of "sustainable development," which reflects a concern (a) to live within the limits of the world's and the community's resources and (b) to ensure the long-term prosperity and well-being of present and future generations.

Unlike measures of well-being based on economic growth, which implicitly assume that a rising tide lifts all boats, sustainable development measures acknowledge that there is no such thing as an indefinitely rising tide and that the metaphor seriously distorts nature's processes. Measures based on a recognition of *limited* resources therefore acknowledge that societal well-being is a *distributional* issue and that poverty will not be solved simply by producing *more* goods and services.

For this reason, measures of equity and income distribution constitute one of the 22 core components of the Nova Scotia GPI. Unlike the GDP, which can grow despite increasing inequity and poverty, the GPI goes up when equity increases and when poverty is

[1] For one of the most thorough and systematic critiques of the economic growth paradigm, see Daly, Herman, *Beyond Growth,* Beacon Press, Boston, 1996.

reduced. The *Ecological Footprint* analysis, by recognizing explicitly the relationship between income, consumption and environmental impact, links environmental sustainability to social equity more clearly and directly than any other component of the index.

That understanding is firmly rooted in accepted definitions of sustainable development. Both inter-generational and intra-generational equity are cited as specific characteristics of sustainability in the Brundtland Commission's seminal definition of sustainable development:

> *Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs... But physical sustainability cannot be secured unless development policies pay attention to such considerations as changes in access to resources and in the distribution of costs and benefits. Even the narrow notion of physical sustainability implies a concern for social equity between generations, a concern that must logically be extended to equity within each generation.*[2]

Statistics Canada notes that, from this definition,

> *A consensus has emerged that sustainable development refers at once to economic, social and environmental needs... A clear social objective that falls out of the definition (of sustainable development) is that of equity, both among members of the present generation and between the present and future generations... It is clear that the spirit of sustainable development implies that all people have the right to a healthy, productive environment and the economic and social benefits that come with it.*[3]

The power of the ecological footprint is, therefore, that it explicitly links environmental sustainability and social justice, not as a matter of ethics or ideology, but as a simple matter of empirical description. If wealthy nations and wealthy individuals consume more resources and produce more waste and greenhouse gas emissions, then their impact on the environment is proportionately greater.

In a world of limited resources and limited waste assimilation capacity, excess consumption by the rich literally requires that others live in poverty if we are not to exceed the Earth's physical carrying capacity. Conversely, greater equity and a reduction in poverty require that excess consumption be curbed. In sum, ecological footprint analysis cuts through the illusion that we can improve the living standards of the poor without *also* examining closely the consumption patterns of the rich.

4) Finally, most components of the Genuine Progress Index, including the natural resource accounts, assess local impacts of local practices. For example, Nova Scotians will experience directly the impact of unsustainable timber or fish harvesting just as they

[2] World Commission on Environment and Development (Brundtland Commission), 1987. *Our Common Future,* Oxford University Press, New York.
[3] Statistics Canada, 1997, *Econnections: Linking the Environment and the Economy: Concepts, Sources and Methods of the Canadian System of Environmental and Resource Accounts*, catalogue no. 16-505-GPE, Ottawa.

experience the costs of crime. However, the reality of an interdependent world and a global economy is that local behaviour has global impacts, and that distant events impact Nova Scotians. Local greenhouse gas emissions, for example, impact global warming that may produce flooding in Bangladesh; and the destruction of the Amazon rainforest will affect the climate of Canada.

A particular contribution of the *Ecological Footprint* analysis, therefore, is its recognition that local consumption practices may involve natural resource depletion far away. Wackernagel and Rees recognize that we may indulge unsustainably high levels of consumption in North America, perhaps even without depleting local resources, but rather by "appropriating the carrying capacity" of other countries through trade. The global perspective of the *Ecological Footprint* approach is an important reminder that, ultimately, Nova Scotia's "genuine progress" cannot be assessed in isolation from our impact on the world.

For all these reasons, the *GPI Ecological Footprint* is an essential complement to the GPI natural resource accounts, and a central component of the Nova Scotia Genuine Progress Index.

For more details on the purposes, principles and framework of the Nova Scotia Genuine Progress Index, please see the Appendices to this report or visit the GPI web site at www.gpiatlantic.org

PART II
ECOLOGICAL FOOTPRINT – A GLOBAL VIEW

2. What The Ecological Footprint Measures

A "sustainable" society ensures the social, environmental, and economic well-being of all people without compromising the well-being of future generations. A tool known as ecological footprint analysis, developed by researchers at the University of British Columbia, enables us to measure progress towards sustainability by measuring the impact of human activities on the environment according to how much land it takes to produce the resources necessary to sustain those activities. This study is believed to be the first provincial ecological footprint analysis undertaken in Canada.

The *Nova Scotia Ecological Footprint* assesses how much biologically productive area Nova Scotians need and utilize to maintain their current lifestyles. The results provide a benchmark of how sustainable our current lifestyles are and they identify the challenges Nova Scotians face to reduce their ecological footprint and their impact on the environment. The study also suggests what individuals can do to reduce their personal ecological footprint, and provides a mechanism to document progress toward a more sustainable Nova Scotia. Unlike measures of progress based on the Gross Domestic Product (GDP) and related economic growth statistics in which "more" is assumed to be "better," a *smaller* ecological footprint indicates greater sustainability and thus is considered a sign of progress in the Genuine Progress Index (GPI). The smaller our ecological footprint, the less we are depleting the Earth's limited resources and degrading the natural environment, and the healthier the natural legacy and wealth we leave to our children.

The ecological footprint concept is based on the simple maxim that all human activities depend on nature, which is the basis of all life support functions. Nature provides the air we breathe, our food and water, the energy we need for heat, light, transportation and to operate our machines, and the materials we use to build our houses and to make our clothes, computers, cars, paper products and every other object that cycles through the economy. Nature also acts as the dump for our waste products. The carbon dioxide, acid gases, and particulate matter that our cars emit, the phosphates from our detergents and fertilizers, the synthetic chemicals found in plastics, paints and other artificial products, and the garbage we put out on the curb each week all end up in our environment.

Human beings therefore have an impact on the Earth simply because they consume nature's products and services. Our personal ecological footprint, therefore, corresponds to the *amount* of nature we use or occupy in order to live. This need not be of concern as long as the human load remains within the "carrying capacity" of nature. "Carrying capacity" refers to the ability of the natural world to support human activity and renew itself without depleting natural resource stocks. The sustainability challenge, therefore, is to attain a high quality of life for all Nova Scotians while ensuring that our resource consumption and waste generation remain within the carrying capacity of nature.

But are we currently living in such a way? Ecological footprint analysis was designed to answer this question by determining the extent of our impact on nature and whether this impact can be sustained into the future. It shows how much productive land and water a given population requires to produce **all the resources it consumes** and to take in all the **wastes it creates.** The ecological footprint therefore becomes a benchmark for measuring the "bottom line" of sustainability. A footprint that corresponds with the capacity of nature to renew itself, to continue providing a flow of goods and services into the future, and to assimilate wastes without overloading the environment, represents the precondition necessary for securing the well-being of present and future generations.[4, 5, 6, 7, 8]

Most measures of sustainable development subtly place responsibility on *producers*. Natural resource accounts for forests, fisheries, soils and agriculture, for example, assess whether current harvesting practices are sustainable. Ecological footprint analysis, by contrast, shifts responsibility to *consumers* by assessing the impact of consumption patterns on the natural world. The ecological footprint perspective cuts through the tendency to blame farmers, loggers, fishermen and businesses alone for the depletion and degradation of natural resource stocks, and places greater responsibility on the *demand* that consumers generate, and which producers aim to fulfill. The critical importance of this component of the GPI, therefore, is to make the sustainability challenge the shared collective responsibility of *all* Nova Scotians.

Ecological footprint calculations are based on two simple facts: First, most of the resources we consume and the wastes that we generate can be accounted for. Secondly, we can convert this resource consumption and waste generation into the biologically productive area necessary to sustain these functions. The ecological footprint of any defined population (a single person, household, province, country) is the biologically productive area required to:

1) produce the food, wood, energy and all the other resources that humans consume,
2) to provide room for infrastructure such as buildings and roads, and
3) to absorb the wastes, carbon dioxide and other pollutants that result from human activity.

To provide results in comparable units of measure, all components are adjusted for their biological productivities. This means that land with higher than average productivity appears larger in footprint accounts than resource-poor land.[9] Since the resources we consume come from

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[4] The ecological footprint concept discussed throughout this report is based on the work of Mathis Wackernagel and William E. Rees, 1996. *Our Ecological Footprint: Reducing Human Impact on the Earth.* New Society Publishers, Gabriola Island, BC. For details on the book, see www.newsociety.com/oef.html. For more details on the footprint method and its applications, visit Redefining Progress at www.rprogress.org or the Anáhuac University of Xalapa's Centre for Sustainability Studies in Mexico at www.edg.net.mx/~mathiswa.

[5] Wackernagel, Mathis., Onisto, Larry., Patricia Bello, Callejas Linares, A.,Ina, López Falfán, I.S., Méndez García, J., Suárez Guerrero, A.I., and Suárez Guerrero, M.G., 1999. "National natural capital accounting with the ecological footprint concept," *Ecological Economics,* Vol. 29, pp. 375-390.

[6] Lewan, Lillemor., Wackernagel, Mathis., and Carina Borgstrom Hansson, 1999. *Evaluating The Use of Natural Capital With Ecological Footprint: Applications In Sweden and Subregions*. Ph.D. work.

[7] Onisto, Lawrence J., Krause, Eric, and Mathis Wackernagel, 1998. *How Big Is Toronto's Ecological Footprint? Using the Concept of Appropriated Carrying Capacity For Measuring Sustainability.* Centre for Sustainable Studies and the City of Toronto, Toronto, Canada.

[8] Mathis Wackernagel, Larry Onisto, Alejandro Callejas Linares, Ina Susana López Falfán, Jesus Méndez García, Ana Isabel Suárez Guerrero, Ma. Guadalupe Suárez Guerrero, 1997. *Ecological Footprints of Nations: How Much Nature Do They Use? How Much Nature Do They Have?* Commissioned by the Earth Council for the Rio+5 Forum. International Council for Local Environmental Initiatives, Toronto.

[9] As noted, land with higher than average productivities appears larger in footprint accounts. The same is done on the capacity side when a region or nation's ecological capacity to accommodate footprints is analyzed.

all corners of the planet and the wastes we generate impact distant places, ecological footprint analysis considers the sum of all our ecological impacts no matter where they occur on the planet. For example, if Nova Scotians eat bananas from Guatemala and use wood from the Amazon rainforest, the land area required in those countries to produce these commodities consumed in Nova Scotia is counted as part of the Nova Scotian footprint.[10, 11, 12]

It is important to note that current ecological footprint estimates err on the conservative side. Low-end figures have been consistently used; areas set aside for the protection and treatment of water have not been included, and areas for the absorption of wastes, pollutants and toxic materials, with the exception of carbon dioxide, have been omitted. In addition, the footprint analysis takes no account of the probability that chemical pesticide and fertilizer use, soil compaction, clear-cutting and other non-sustainable harvesting practices will reduce future soil productivity. The current biological productivity of a given piece of land is assumed to continue into the future. These assumptions render current footprint analyses highly conservative.

3. Methodology

The Nova Scotia ecological footprint is based on the methodology developed by William Rees and Mathis Wackernagel of the University of British Columbia, in their book "Our Ecological Footprint: Reducing Human Impact on The Environment" and, more specifically, on the results presented in Mathis Wackernagel's 1996 Canadian Ecological Footprint estimate, which was part of the *Living Planet Report* published by the World Wide Fund For Nature.[13, 14] The Wackernagel and Rees approach, often referred to as the "compound" approach to calculating the ecological footprint, measures consumption based on quantity and type of consumption as well as trade flows and energy data.[15]

Wackernagel, Mathis, 2001. *What We Use and What We Have: Ecological Footprint and Ecological Capacity,* Redefining Progress (www.rprogress.org).

[10] WWF International (www.panda.org), Redefining Progress (www.rprogress.org), UNEP-WCMC (www.unep-wcmc.org), Center for Sustainability Studies (www.edg.net.mx/~mathiswa), 2000. The *Living Planet Report 2000* is available at http://panda.org/livingplanet/lpr00 or www.rprogress.org/ef/LPR2000.

[11] Wackernagel et al., 1997. See footnote 8.

[12] Wackernagel and Rees, 1996. See footnote 5.

[13] Idem.

[14] Redefining Progress and the Center for Sustainability Studies contributed to the *Living Planet Report 2000* by calculating the ecological footprint of the world's 150 countries with a population over 1 million, using 1996 data, as well as the ecological footprint for the world population from 1961 to 1997. Calculations are available at http://panda.org/livingplanet/lpr00 or www.rprogress.org/ef/LPR2000. The original study of national footprints was: *Ecological Footprints of Nations: How Much Nature Do They Use? How Much Nature Do They Have?* See footnote 8. The methods are also described in Wackernagel et al., 1999 (footnote 5).

[15] An explanation of the "compound approach" and other approaches to calculating the ecological footprint are available in Chambers, Nicky, Simmons, Craig and Wackernagel, Mathis, 2000. *Sharing Nature's Interest.* Earthscan Publications Ltd, London, p.67.

The Compound Approach to Footprint Calculations

The following excerpt, from p.67 of *Sharing Nature's Interest* by Nicky Chambers, Craig Simmons and Mathis Wackernagel, summarizes the main elements of the ecological footprint methodology.[16]

"The calculation is composed of three main parts. The first part consists of a consumption analysis of over 50 biotic resources including meat, dairy, produce, fruit, vegetables, pulses, grains, tobacco, coffee, wood products, and so on. Consumption is calculated by adding imports to production and subtracting exports. Where necessary, further adjustments are made to avoid double counting across categories. For example, grain-fed animals are accounted for by feed consumption (as arable land) rather than by grazed pasture land. Using FAO estimates of world average yield, consumption is translated into appropriated ecologically productive area. In other words, the consumption quantities are divided by their corresponding (world average) biotic productivity, which gives arable, pasture, or forest land and productive sea area necessary to sustain this consumption.

The second part of the calculation determines the energy balance – considering both locally generated energy and that embodied in over 100 categories of traded goods. Where the primary fuel used is known, this is adjusted for carbon content. This portion of the calculation is used to derive the energy footprint – usually the amount of forested land necessary to sequester the CO_2 emissions.

The final part of the calculation summarizes the ecological footprint in six categories and gives the total, presented as per capita figures. Multiplying the per capita data by the country's population gives the total footprint of the nation. An adjustment is also made to express the result in world average productive land. 'Equivalence factors' are used to scale the land categories in proportion to their productivities. The total is then compared with an estimate of how much biocapacity exists within the country. The actual land area is adjusted by a 'yield factor' to equate local productivity of each land category to the global average. This scales the national areas in proportion to their true productivities. The total area of bioproductive land is reduced by 12 per cent to account for biodiversity needs. The remaining 88 per cent is referred to as the 'available land.'"

The compound approach to ecological footprint calculations takes its primary unit of analysis as the nation state. Reliable data on trade flows, consumption, energy use and land categories are available at the national level. However the complete data set necessary to calculate the ecological footprint at the provincial level using the compound approach is not currently available, primarily due to inadequacies in the inter-provincial trade flow data.

Therefore, the Nova Scotia ecological footprint was calculated indirectly by adjusting the per capita Canadian footprint area, as calculated by Rees, Wackernagel and their colleagues, to account for differences in consumption patterns between Nova Scotia and Canada. This is the approach recommended by Wackernagel who notes that "regional or municipal footprints can be extracted from the national footprint by comparing to what extent the consumption in the region or municipality differs from the national average and adjusting the footprint accordingly."[17]

[16] Idem. For more information please refer to: Chambers et al., 2000 (footnote 15) and Wackernagel and Rees, 1996. *Our Ecological Footprint: Reducing Human Impact on the Earth.* New Society Publishers, Gabriola Island, BC.

[17] Wackernagel, Mathis (1998), "The Ecological Footprint of Santiago de Chile," *Local Environment*, Vol 3,, No. 2, p. 16. Chambers et al. (2000) also support this approach: "Where specific data about a city are not known then its footprint can be estimated by apportioning the per capita impact" (p.135). See footnote 15. Despite excellent work by Statistics Canada on inter-provincial trade flows, uncertainties in the data still do not permit accurate estimates

That is the procedure followed in this report. The Nova Scotia consumption adjustments rely primarily on the following Statistics Canada surveys and sources: *Food Expenditure Surveys, Family Expenditure Surveys, Spending Patterns In Canada, Food Consumption in Canada, Canadian Economic Observer, Report on Energy Supply-Demand In Canada* and other sources as listed in the footnotes. National Energy Board figures were used to calculate Nova Scotia's energy footprint.

GPI *Atlantic* recognizes that using input-output tables at the provincial level to track resource and waste flows through the economy would be a more accurate and comprehensive way of calculating human impacts on the environment. GPI *Atlantic* has recommended to Statistics Canada that future updates of this report use the expanded input-output tables in the Material and Energy Flow Accounts that are part of Statistics Canada's new Canadian System of Environmental and Resource Accounts. Although Statistics Canada has developed conventional provincial input-output tables, the expanded Material and Energy Flow Accounts still exist only at the national level. Statistics Canada hopes to develop corresponding provincial and regional accounts in the future, which will allow for significant improvements in the ecological footprint calculations.

GPI *Atlantic* is only aware of one study to date that has used input-output tables to calculate an ecological footprint. Interestingly, that New Zealand study produced results that were quite close to those based on the methodology of Wackernagel and Rees in British Columbia. For that reason, and because of the conservative assumptions described above, the author and GPI *Atlantic* are confident that the results presented in this analysis are reasonable estimates.[18] At the same time, we recognize clearly the limitations of the methodologies used in this study and welcome improvements that will increase the accuracy of the estimates given here.

4. Understanding the Ecological Footprint

The Ecological Bottom Line

If we divide all the biologically productive land and sea on this planet by the human population in the year 2000, there is an average of 2.1 hectares of biologically productive land and sea per person. If we set aside 12% of the ecologically productive land for biodiversity preservation, as recommended by the Brundtland Commission, the available bioproductive space per person shrinks from 2.1 hectares to just under 1.8 hectares.[19, 20]

of provincial imports and exports of the more than 100 categories of traded goods considered in the compound approach to ecological footprint calculations.

[18] A study undertaken by Bicknell et al., from Lincoln University, Canterbury, New Zealand used input-output tables to calculate a New Zealand ecological footprint. Interestingly, the New Zealand analysis, using an entirely different method, produced comparable results to the original UBC analysis. Bicknell, Kathryn B., Richard J. Ball, Ross Cullen, Hugh R. Bigsby, 1998. "New methodology for the ecological footprint with an application to the New Zealand economy," *Ecological Economics* Vol. 27, 149-60. See also Statistics Canada, 1997 (footnote 3).

[19] Mathis Wackernagel in his Canadian Footprint analysis follows the internationally accepted Brundtland Comission recommendation to set aside 12% of bioproductive area for biodiversity preservation in order not to exaggerate ecological scarcity. The *Living Planet Report 2000* (see footnote 10) sets aside 10%, while conservative biologists recommend a minimum of 30%. The burden of this protection effort must clearly be

Since we share the planet with over 10 million other species, it is clearly not possible to use the entire bioproductive ecological space of the planet solely for human consumption. Indeed, it is doubtful that the human species itself could survive if it used all productive resources for its own needs at the expense of all other species. Conservative biologists recommend a minimum set-aside of 30% for biodiversity preservation, so the 12% set-aside, recommended by the Brundtland Commission and used in this report, actually minimizes the ecological scarcity seen by many scientists.[21] Indeed, the 12% target is what is currently deemed *politically* feasible based on international agreements. The actual biodiversity preservation required for the longer-term self-preservation of the human species and to slow the current extreme rate of species extinction will likely require *greater* land protection.

In sum, sustainable living therefore requires that each global citizen fulfill all his or her physiological, social, and economic needs within the 1.8 hectares of biologically productive space available to each person. Any increase in the set-aside for biodiversity preservation will correspondingly decrease that estimate of available space.

The sustainability challenge will not become any easier with a projected population of 10 billion people within the next 30 to 50 years. At that time, the available space will be reduced to 1.2 ha. per person worldwide. Again it must be emphasized that this projection has not factored in the probable loss of biologically productive space due to unsustainable harvesting methods, clear-cutting, soil erosion, and the expansion of the built environment, nor does it include the impact of most waste products. Given these highly conservative assumptions and exclusions, the 1.2 ha. per person can be considered a very generous estimate.[22]

The Current Human Footprint Exceeds the Sustainable Capacities of the Earth

The current global ecological footprint is 2.8 ha. per person.[23] With an available space of just 1.8 ha. per person, humanity already exceeds the sustainable capacity of the Earth by over 50%. This means that humanity is consuming more than nature can regenerate. This global "overshoot" is temporarily possible, but only by:

- depleting reserves of natural capital (oil, natural gas, old growth forests);
- over-harvesting renewable resources to the brink of collapse (the Atlantic cod fisheries);
- causing irreversible ecological damage (species extinction,[24] desertification); and

shared by all of humanity and not only those regions of the world where biologically productive spaces remain relatively untouched by humans (Wackernagel, 2001. See footnote 8).

[20] Brundtland, G. H., 1987. *Our Common Future*, Report of the World Commission on Environment and Development, chaired by Gro Brundtland, Oxford University Press, p.166.

[21] Wackernagel, Mathis, 2001. *What We Use and What We Have: Ecological Footprint and Ecological Capacity,* Redefining Progress (www.rprogress.org).

[22] WWF International (www.panda.org), Redefining Progress (www.rprogress.org), UNEP-WCMC (www.unep-wcmc.org), Center for Sustainability Studies (www.edg.net.mx/~mathiswa), 2000. The *Living Planet Report 2000* is available at http://panda.org/livingplanet/lpr00 or www.rprogress.org/ef/LPR2000.

[23] *Living Planet Report 2000,* op. cit.

[24] Morell, Virginia, 1999. "The Sixth Great Extinction," *National Geographic*. Vol. 195, No. 2.

- overloading our environment with waste products (causing air and water pollution, climate change, stratospheric ozone depletion, and toxic chemical build up).

To take just one example from this list, scientists estimate that 100 living species become extinct every day, largely from habitat destruction and pollution. If current trends continue, 50% of the world's flora and fauna will become extinct within the next century. The present species extinction rate is estimated to be 1,000 times the natural rate.[25]

For a while, many of us can live quite comfortably in the midst of this overshoot and will not pay for its consequences in our own lifetimes. But our comfort is quite clearly at the expense of future generations who will pay the ecological costs of current over-consumption as surely as present generations are now paying the costs (in higher tuition fees and reduced government services) of excess spending and debt accumulation in the 1970s and 1980s. Not only does the current ecological overshoot deplete the biologically productive space or footprint area that will be available for our children and their children to achieve healthy lives, but it also leaves them to deal with the toxic impacts of excess current waste generation. Reduced salmon and cod stocks, global warming, higher child asthma rates, and new environmental illnesses may well be current precursors of these longer-term consequences.

A simple, but operational understanding of what sustainability means

"Sustainability is a simple idea. It is based on the recognition that worsening ecological conditions ultimately threaten people's well-being. Thus, sustainability is… a commitment to satisfying lives for all within the means of nature.

When humanity's ecological demands in terms of resource consumption and waste generation exceed what nature can supply, we move into what is termed 'ecological overshoot.' Just as constant erosion of business capital weakens an enterprise, such overshoot erodes the planet's 'natural capital,' and thus reduces the ultimate means people depend on.[26]

At the core of the quest for sustainability is the need to be able to live with ecological limits. These limits are not like a rigid wall that brings a speeding car to a halt. Rather, ecological limits can be transgressed easily. More timber can be harvested than regrows, more fish can be caught than are spawned, more CO_2 can be emitted than nature can reabsorb, and topsoil can be eroded while crops grow. Initially, most of these transgressions go unnoticed.

The importance of avoiding overshoot is still ignored not only in general conversations but also in many public policy discussions of sustainability. In fact, our ability to transgress ecological limits without perceptible consequences may create influential misconceptions in the sustainability debate. For example, in a recent interview on reaching a world population of 6 billion, Nafis Sadik, then Executive Director of the UN Population Fund, stated that 'many environmentalists think [that the carrying capacity of the Earth] is four billion, maximum. But now we have six billion people.'[27]

[25] Idem.
[26] See also Daly, Herman, *Beyond Growth,* Beacon Press, Boston, 1996.
[27] Jim Motavalli, 1999. "Conversations with Dr. Nafis Sadik: The UN's Prescription for Family Planning," *E: The Environmental Magazine,* Vol. 10, No.4, 10–13.

Overshoot is also the driver behind inequities. In a world that is in overshoot, people not only compete with other species for ecological space, but against each other. Overshoot obscures this reality by allowing the accumulation of 'ecological debts' (or the depletion of the natural capital stock), leaving the burden for future generations. In other words, it makes possible the trade off between increasing resource depletion, intragenerational equity and intergenerational equity.

Overshoot is not merely an abstract construct, but can be measured. This translates the 'means of nature' into a specific and accountable proposition."

Mathis Wackernagel, 2001[28]

Strong Sustainability or Weak Sustainability

This approach is consistent with the notion of "**strong sustainability**" which requires that *natural* capital not be depleted, and that human societies live off the "interest" (or services provided by natural capital stocks) without drawing down the "principal" (the natural capital stocks themselves). The concept of "**weak sustainability**," by contrast, implies that there be no depletion of *total* capital, i.e. natural plus human-made capital. Weak sustainability policies allow natural capital to be diminished as long as it is compensated by a commensurate increase in human-made capital.

Apart from serious problems arising from the lack of adequate methods to compare the value of human-made and natural capital, such weak sustainability would assume that there is **substitutability** between human-made and natural capital. While there is some substitutability among different aspects of natural capital (e.g. fuel wood versus bio-fuel from corn), and even some marginal substitutability between natural capital and human-made capital (e.g. fuel-wood versus wind-mills), there is no absolute substitutability for essential ecosystem services, since human and non-human life ultimately depend on the functioning of the biosphere. Put simply, the relationship between natural and human-made capital is not an equal two-way flow. The human economy and human society depend completely on nature (for air, water, heat, energy, productive land, resources, climate regulation and other vital ecosystem services), but nature does not depend for its survival on human economy and society. That reality makes the assumption of substitutability highly questionable, although the assumption is widely accepted in actual practice.

In addition, it *may* be possible to substitute human-made capital for certain *functions* of particular natural capital assets. But these natural assets frequently perform a wide range of functions, many of which are not performed by the human-made substitute. For example, a sewage treatment plant may partially replace the natural waste cycling capacity of a river or other water body, but it cannot compensate for the many other vital life-supporting ecological functions performed by the river. In other words, the sewage treatment plant does not make the river dispensable nor allow its health to be compromised without a wide range of other consequences, many of which are likely to be adverse to human well-being.

In the past, weak sustainability may have appeared as a sufficient criterion for beneficial development. But this illusion can no longer be sustained in a time of global overshoot. Since humanity is using the biosphere's capacity more rapidly than it can regenerate, further trade-offs of building human-made capital at the expense of natural capital in order to maintain or increase total capital are highly likely to undermine the well-being of future generations.

[28] Wackernagel, Mathis, 2001. *Framing Sustainability with the Ecological Footprint – Dismantling the taboo in order to unleash sustainability,* Draft Document prepared for Environment Canada workshop on sustainable development indicators, January 23, 2001, Toronto, p. 2.

Nevertheless, strong sustainability by no means condemns humanity to stagnation nor does it imply any barrier to human and social development and progress. On the contrary, long-term stagnation and regression are more likely under weak sustainability policies, since those policies could continue to liquidate the natural capital assets on which human economic prosperity ultimately depends. By contrast, strong sustainability provides stronger guarantees of long-term prosperity by preserving natural wealth for the benefit of future generations. Under such policies, societies are more likely to flourish through the development of appropriate technologies that can provide services to society without drawing down natural capital reserves. As well, efforts to stabilize human population and curb excessive material consumption can help foster human and social development without increasing ecological overshoot. See also Daly Herman, *Beyond Growth,* Beacon Press, Boston, 1996.

Based on notes from Mathis Wackernagel, personal communication, 2001 and Wackernagel and Rees, *Our Ecological Footrint*, 1996, p. 37.

Not All Footprints Are the Same Size

Responsibility for this overshoot is not equally shared. As Figure 1 demonstrates, there is a great disparity among different countries' ecological footprint sizes, with wealthy nations having a disproportionately greater impact on the environment.

As Figures 1 and 2 clearly show, the industrialized regions tend to live on footprints significantly larger than the less industrialized regions of the world. For example, Africa and the Asia/Pacific region have ecological footprints of 1.3 ha. per capita and 1.8 ha. per capita respectively, while North America and Western Europe have ecological footprints of 11.8 ha. per capita and 6.3 ha. per capita respectively.

Figure 2 shows the ecological footprints of seven geographical regions of the world in 1996.

- The size of each box is proportional to the aggregate footprint of each region.
- The height of each box is proportional to the region's average ecological footprint per person; and
- The width of the box is proportional to the population of the region.

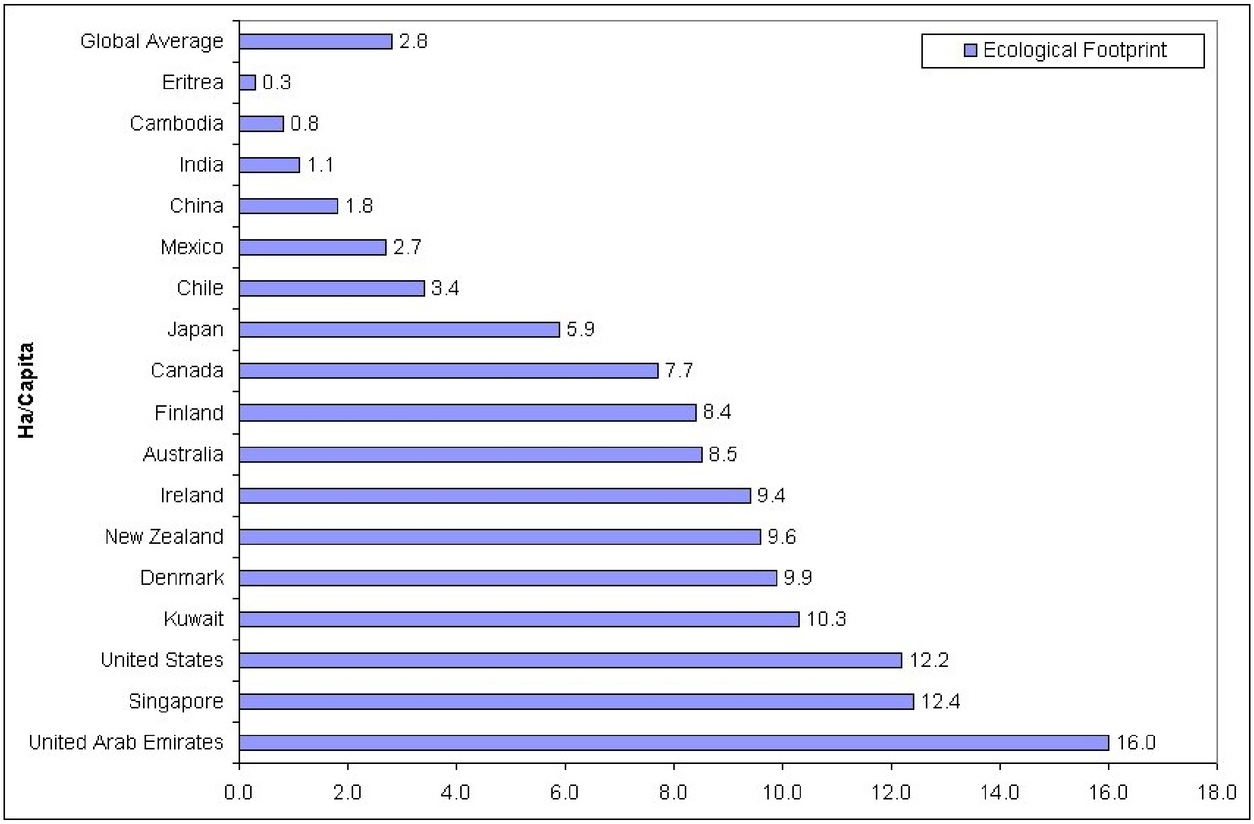
(The OECD and non-OECD columns refer only to average ecological footprint per person).

In fact, four billion people, or seventy percent of the world's population, consume an average of just 1.3 ha. of bioproductive capacity per person, considerably less than the 1.8 ha. per capita of land and sea space available for human use (Figure 3).[29] Arguably global environmental decline can therefore be attributed to 30% of the world's population – the 1.8 billion people who consume an average of 6.5 hectares of productive space per person. In fact, this 30% of the world's population is responsible for 70% of global resource consumption and waste generation and has an aggregate ecological footprint equal to 90% of the Earth's total area.[30]

[29] Total population (1996) for countries with an ecological footprint of 1.8 ha. or less = 4.0 billion. Total population (1996) for countries with an ecological footprint greater than 1.8 h = 1.8 billion. Estimates derived from the *Living Planet Report 2000* data tables. See footnote 10.

[30] The 30% of the population with the largest footprint is responsible for 70% of the world's resource consumption and waste generation. Because globally we are in a state of overshoot the actual footprint area that this group occupies is equal to an area the size of 90% of the Earth's total area.

Figure 1. Great Disparity in Ecological Footprint Size[31]



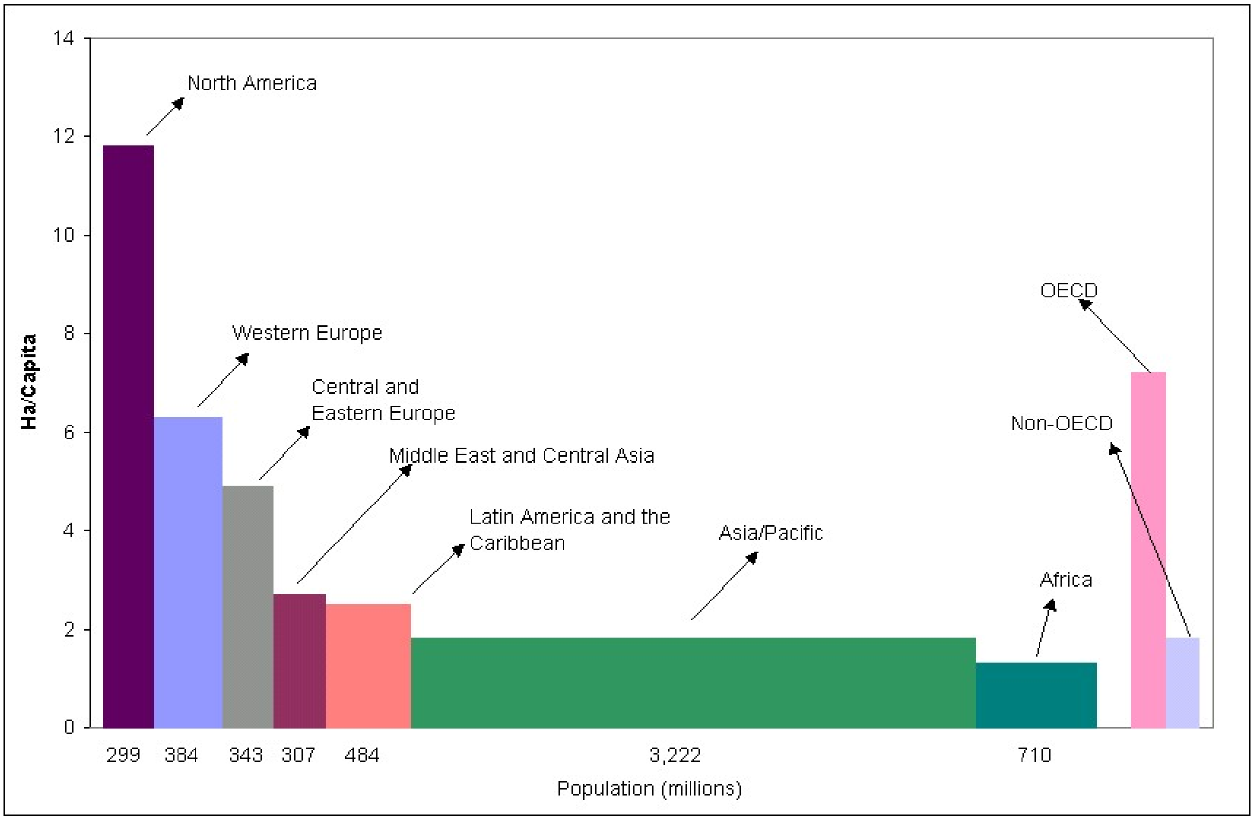
Source: WWF, 2000. Living Planet Report 2000.

This group of consumers is largely concentrated in the OECD nations whose per capita ecological footprint is 7.2 ha. By contrast, the non-OECD countries have an average ecological footprint of 1.8 ha./per capita, which corresponds exactly to the bioproductive space available for human use.[32] As Figures 2 and 3 indicate, most people in Africa, Asia and the Pacific region consume considerably less than that average per capita biocapacity available for human use. Since the available bioproductive space is finite, it is clear that excessive consumption in the rich nations directly undermines the ability of many others to secure their basic human needs.

A caveat must be added here. The country figures on which these estimates are based do not account for income disparities within nations. Excessive consumption by even a small proportion of the population of poor nations may raise average footprint sizes and conceal the poverty of a significant proportion of the population. Even though Brazil's average footprint is 2.6 ha. per person, for example, the great income disparities in that country indicate that many millions of Brazilians may have a footprint size closer to the African average of 1.3 ha. per person.

[31] Country ecological footprints are from the *Living Planet Report 2000.* See footnote 10.
[32] Based on *Living Planet Report 2000* data tables. See footnote 10.

Figure 2. Ecological Footprint By Region (1996)[33]



Source: WWF, 2000. Living Planet Report 2000.

It has been argued that technological advances, such as genetically modified foods, may effectively expand the bioproductive space available for human consumption by making each hectare of land and sea considerably more productive than it has been historically. In an earlier era, the "Green Revolution" held out the same promise. In keeping with the conservative nature of estimates in this report that exclude the probable degradation and loss of currently productive land to soil erosion, compaction, nutrient leaching, desertification, pollution and other factors, and acknowledging that bioengineering and other yield-expanding innovations are still in the experimental stage, this report assumes the same bioproductive capacity for each hectare of land into the future as currently exists. From that perspective, available resources remain finite, and excess consumption and waste generation by some in effect depend on the continued poverty and deprivation of others.

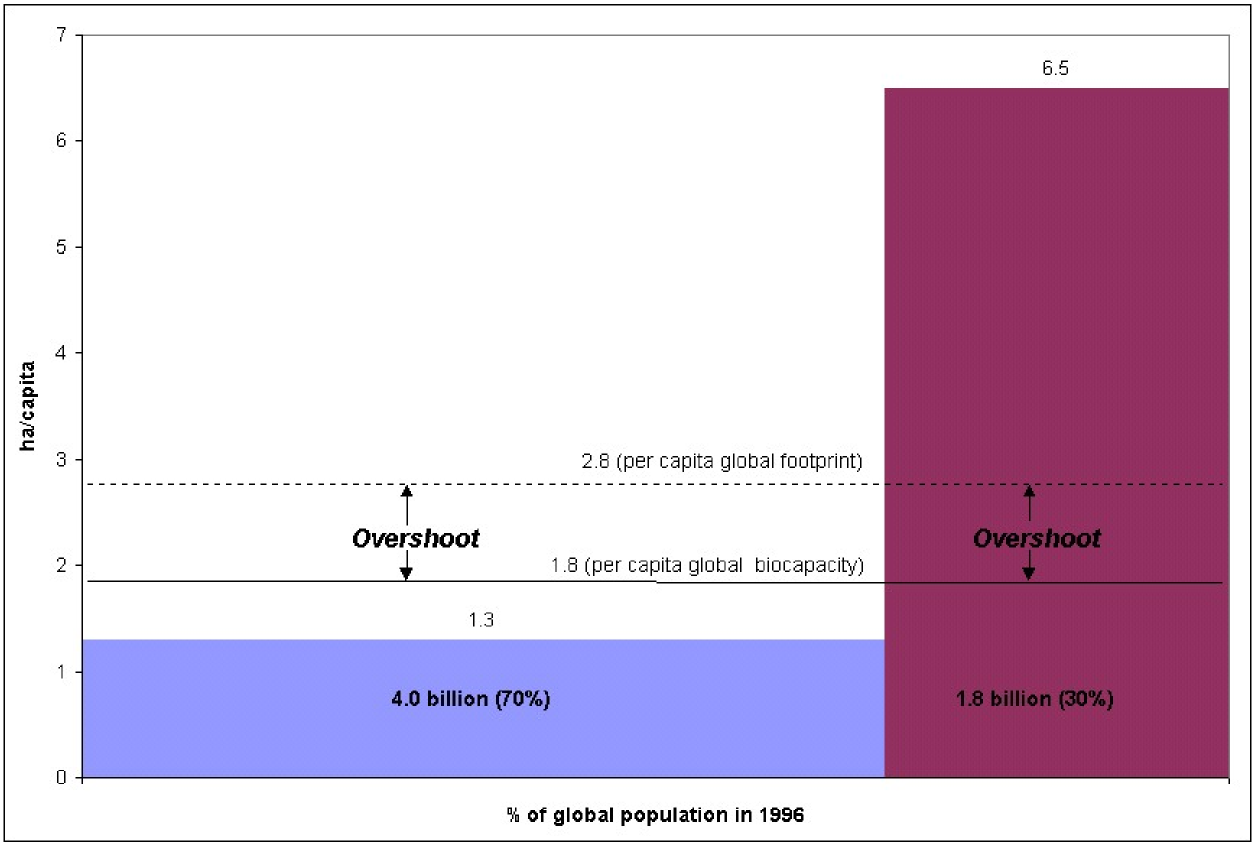
Figure 3 illustrates both the *average* current per capita ecological overshoot, and the overshoot of 30% of the world's population. Figure 4 reveals the remarkable distribution of ecological footprints by percentage of the world's population. The 5% of the world's population[34] with the

[33] Figure 2 is a reproduction of Figure 12: Ecological Footprint By Region, 1996, page 10 of the *Living Planet Report 2000*. See footnote 10.

[34] This includes Estonia, Hong Kong, France, Sweden, Canada, Finland, Australia, Ireland, New Zealand, Kuwait, Denmark, United States of America, Singapore, United Arab Emirates. Based on *Living Planet report 2000* ecological footprint results and population figures. See footnote 10.

largest ecological footprints (including Nova Scotia, the other Canadian provinces, and the U.S.) have an average footprint of 11.9 ha./capita or 8.5 times the 1.4 ha./capita footprint of 54% of the world's population, and 15 times the 0.8 ha./capita footprint of the poorest 10%.

Figure 3. Global Distribution Above and Below 1.8 hectares[35]

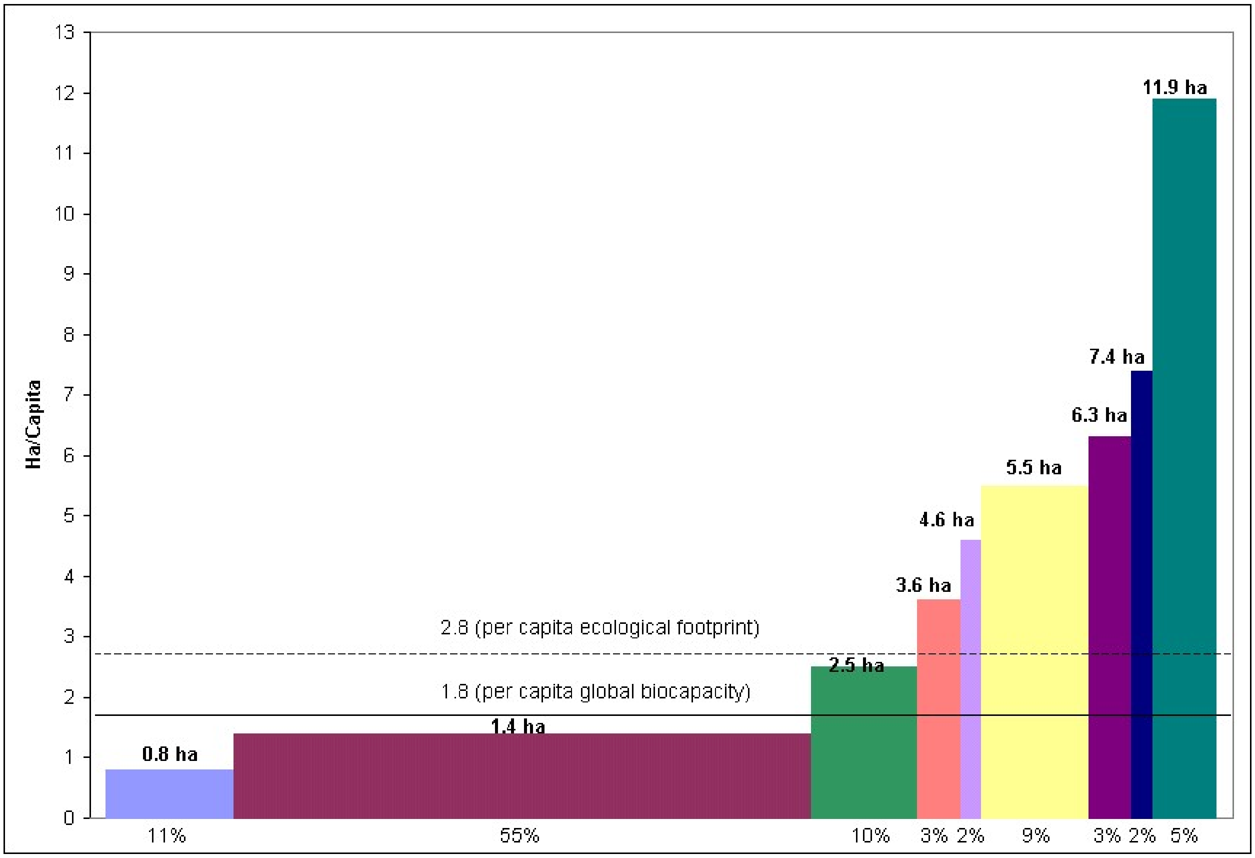


Source: Author's calculations, based on WWF, 2000. *Living Planet Report 2000*.

Ecological footprint studies highlight the ethical dimensions of sustainability. Fourteen countries occupy footprints at least four times larger than the 1.8 ha. of biologically productive space available per global citizen.[36] In marked contrast, 36 countries have footprints of 1 ha. or less per capita.[37]

[35] Based on *Living Planet report 2000* ecological footprint results and population figures. See footnote 10.
[36] Idem.
[37] These 36 countries include Eritea, Afghanistan, Bangladesh, Namibia, Yemen, Congo Dem. Rep., Lesotho, Sierra Leone, Chad, Burundi, Mozambique, Haiti, Bhutan, Guinea Bissau, Angola, Togo, Cambodia, Guinea, Ethiopia, Mali, Malawi, Uganda, Cameroon, Rwanda, Tajikistan, Burkina Faso, Laos, Madagascar, Sri Lanka, Vietnam, Cote D'Ivoire, Benin, Somalia, Niger, Gambia, Nepal, Tanzania. Based on *Living Planet report 2000* ecological footprint results. See footnote 10.

Figure 4. Global Ecological Footprint Breakdown[38]



Source: Author's calculations based on WWF, 2000. *Living Planet Report 2000*.

This empirical reality clearly demonstrates the equity dimension of sustainable development that is explicit in the Brundtland Commission's seminal definition. As noted in the introduction to this report, the Brundtland report remarks that "even the narrow notion of physical sustainability implies a concern for social equity between generations, a concern that must logically be extended to equity within each generation."[39] According to Statistics Canada, "the spirit of sustainable development implies that all people have the right to a healthy, productive environment and the economic and social benefits that come with it." Therefore "equity, both among members of the present generation and between the present and future generations (is) a clear social objective that falls out of the definition."[40]

A finite amount of bioproductive capacity implies that if certain populations overuse resources, there will be less available for others. Raising the living standards and consumption levels of the world's poor without curbing excess consumption in the industrialized world would put an intolerable strain on the Earth's resources and waste assimilation capacity.

[38] Idem.
[39] World Commission on Environment and Development (Brundtland Commission), 1987. See footnote 2.
[40] Statistics Canada, 1997. See footnote 2.

The resource consumption disparities are vast: Globally, the 20% of the world's people in the highest-income countries account for 86% of total private consumption expenditures, while the poorest 20% account for a mere 1.3%.

- *The richest one-fifth consume 45% of all meat and fish, the poorest fifth consume just 5%;*
- *The richest one-fifth consume 58% of total energy, the poorest fifth less than 4%;*
- *The richest one-fifth consume 84% of all paper, the poorest fifth 1.1%*
- *The richest one-fifth own 87% of the world's vehicle fleet, the poorest fifth less than 1%* [41]

The excessive consumption by wealthy individuals and the wealthier regions of the globe clearly occurs at the expense of the poorer regions and of millions living in absolute poverty.

Current resource consumption by the world's poorest citizens is frequently insufficient to meet basic needs. Of the 4.4 billion people in developing countries, nearly three-fifths lack basic sanitation. Almost a third have no access to clean water. A quarter do not have adequate housing. A fifth have no access to modern health services. A fifth of children do not attend school to grade five. And a fifth do not get enough dietary energy and protein. Millions still die annually from chronic hunger and malnutrition.[42]

It is clear that in a world of limited resources, excess consumption by the rich directly undermines the prospects for the poor. Despite our expressed concern to raise the living standard of the world's poorest, we actually *need* a billion human beings to live in absolute poverty without sufficient resources to sustain life and health in order to retain current consumption patterns in industrialized countries.

This is an admittedly crude way of expressing the stark reality that raising global living standards to current levels in the wealthy countries would put an intolerable strain on the Earth's resources. *If everyone in the world were to consume at Canadian and Nova Scotian levels, we would need five planets Earth to provide the necessary resources and waste assimilation capacity.* Ecological footprint analysis therefore makes it clear that global ecological sustainability depends on the affluent reducing their present share of consumption so that those in poverty can meet their basic human needs.[43]

The Connection Between Sustainability and Consumption

Comparing the ecological footprints of various countries effectively communicates the comparative impacts of different levels of consumption on the environment. Figure 5 demonstrates that the average Canadian person has an ecological footprint seven times greater than that of the average Indian person and over four times greater than that of average Chinese person. This suggests that the average Canadian places the same demand on the planet's resources and waste assimilation capacities as 7 individuals from India and 4 individuals from China.

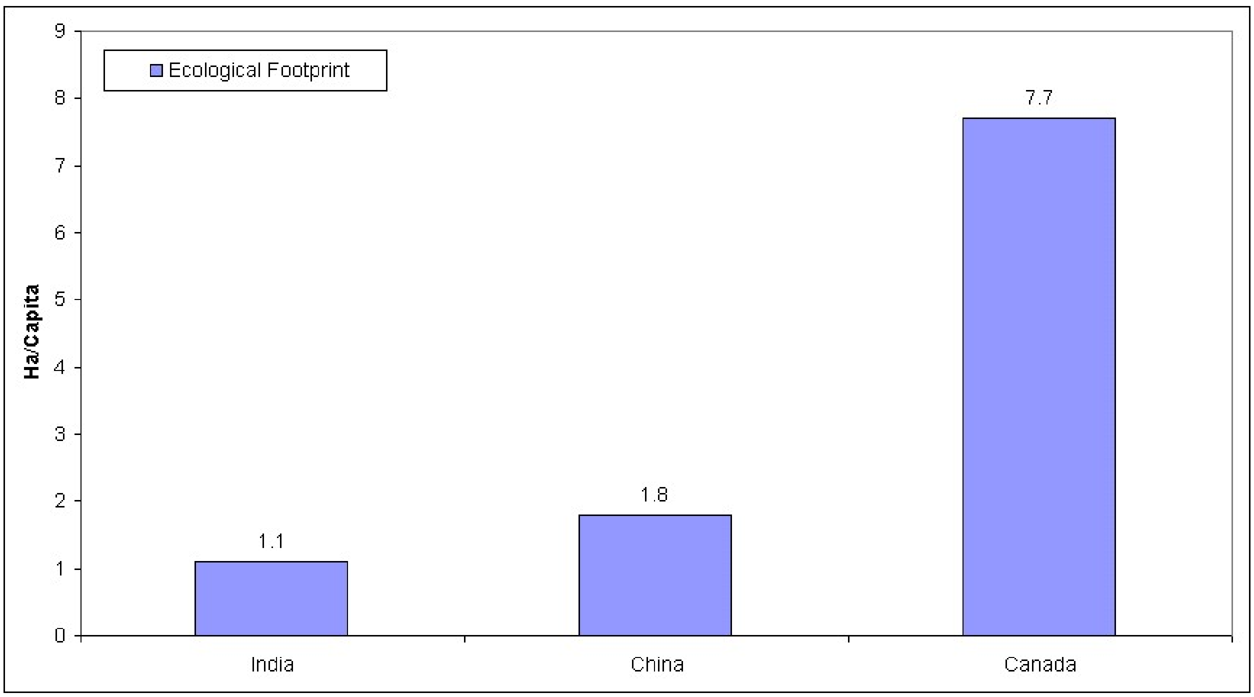
[41] United Nations Development Program 1998. *Human Development Report 1998.* www.undp.org.
[42] Idem.
[43] For more information on ecological footprints and sustainability, see Wackernagel and Rees, 1996 (footnote 11).

This reality sheds a completely different light on the world's "population problem." While there tends to be a global consciousness that sustainability requires the need to address overpopulation, ecological footprint analysis highlights the fact that sustainability is very much a consumption issue and that the impact of population growth is dependent on consumption patterns. For example, the average US citizen has an impact on the environment 20 times greater than that of the average Bangladeshi. The current Bangladesh footprint is 0.6 ha./capita, while the United States footprint is 12.2 ha./capita.

Put another way, every additional American puts a strain on the world's resources equivalent to 20 additional Bangladeshis. Theoretically, the population of Bangladesh, which is now 124 million, could total 5.48 billion before it would place the same human load on the Earth as the United States currently does with its population of 273.8 million.

Even this is a conservative estimate. Erlich et al., using a different methodology, estimate that the average U.S. citizen has an impact on the environment that is 70 times greater than that of the average Bangladeshi. This suggests that the population of Bangladesh could reach 19.1 billion people before placing the same human load on the Earth as the United States with its 273.8 million.[44, 45]

Figure 5. Per Capita Ecological Footprint of India, China and Canada[46]



Source: WWF, 2000. Living Planet Report 2000.

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[44] Erlich et al. (1995) use I=PAT estimates to assess human impact on the environment. The IPAT model assumes that Impact= Population x Affluence x Technology. Erlich, Paul R., Ehrlich, Anne H., and Gretchen C. Daily, 1995. *The Stork And The Plow.* G.P. Putnam's Sons, New York.
[45] United Nations Population Fund. 1998. State of World Population 1998. www.unfp.org.
[46] Based on *Living Planet report 2000* ecological footprint results. See footnote 10.

Simply put, every baby born in Canada or the United States will deplete the Earth's capacity to support human life far more rapidly than many babies born in developing nations. While we are used to describing the population explosion as a problem of developing countries, ecological footprint analysis demonstrates that reducing the population of industrialized nations would have a far greater impact in conserving resources than controlling population in Africa, Asia and the Pacific region.

Summary: Exceeding Global Sustainability Limits

As indicated, sustainability from a global perspective requires that humanity live within the resources and waste assimilation capacity provided by an average of 1.8 hectares per global citizen. Yet the current *average* global ecological footprint of 2.8 hectares per person already exceeds this amount. We are currently able to maintain this ecological overshoot by:

- Depleting stocks of non-renewable natural capital;
- Depleting current ecological capacity in the form of renewable capital at the expense of future generations;
- Appropriating the ecological carrying capacity of other places at the expense of those regions' populations.

PART III
THE NOVA SCOTIA ECOLOGICAL FOOTPRINT

5. How Big Is The Nova Scotia Ecological Footprint?

In 2000, Nova Scotia had a population of 941,000 and a land area of 55,284 km^2 (5,528,400 hectares).[47] A Nova Scotia ecological footprint analysis, based on Mathis Wackernagel's 1996 Canadian ecological footprint analysis, reveals that the area required to sustain current Nova Scotia resource use and waste production is 8.1 hectares (20.0 acres)[48] per person or 9.2 hectares (22.7 acres) per person if the suggested 12% of ecological space for biodiversity is included. This corresponds to the size of 20 football fields put together or three city blocks per person. To calculate your personal ecological footprint visit Redefining Progress' web site at www.rprogress.org/resources/nip/ef/ef_household_calculator.html.[49]

With an average per person footprint of 8.1 hectares, Nova Scotians require 7,600,000 hectares of land to support their current consumption levels. This means that the citizens of Nova Scotia use the productive output of a land area almost 40% larger than the geographical area of the province to sustain themselves.

To maintain current levels of consumption, Nova Scotians not only use the ecological capacity from within their own province but appropriate additional ecological capacity elsewhere on the planet through trade of goods and services that are derived from natural capital.[50] In fact, if we look closely at the products we consume, we will quickly see that the vast majority of materials from which these products are made come from outside the province. In order to maintain current levels of consumption, Nova Scotians therefore are dependent both on the natural capital of their own land base and, to a much larger extent, upon the resources and natural capital assets of other regions.

By maintaining a constant supply of goods, trade disguises the negative consequences of over-consumption and unsustainable resource use by transferring the impacts to other regions. The ecological footprint exposes this discrepancy by attributing the consequences of a given population's consumption directly to that population, no matter where on the planet the impacts occur. For example, one can imagine a society that enjoys high material standards based on the knowledge industries and high-end service sector jobs, and that boasts excellent population

[47] **Population:** Statistics Canada, 2000.Cansim II, Table 051-0001 - Estimates of population, by age group and sex, Canada, provinces and territories, annual. **Land area:** Statistics Canada, 2000. *Canadian Statistics, Land and Freshwater Area*, Available at: www.statcan.ca.

[48] The 1999 Ecological Footprint estimate for Nova Scotia, based on differences in per capita disposable income and consumption expenditures, is actually 8.3 ha. per person. The 8.1 ha. per capita figure is based on 1996 income and consumption data and is derived directly from the most recent Canadian ecological footprint study, with adjustments for differences in consumption patterns. For the sake of comparability with the Canadian footprint, the Nova Scotia ecological footprint based on 1996 consumption data will be used in this report. This allows a somewhat more conservative estimate for the Nova Scotia footprint and allows for consistent comparisons both with Mathis Wackernagel's Canadian footprint and with the international ecological footprint results presented in the *Living Planet Report 2000* which uses the same methodology as Mathis Wackernagel's 1996 Canadian study. Calculation spreadsheets are available by contacting GPI Atlantic at info@gpiatlantic.org.

[49] Other personal ecological footprint calculators developed in conjunction with Redefining Progress can be accessed at Lead International Inc. (www.lead.org/leadnet/footprint/intro.htm) and Mountain Equipment Co-op (www.mec.ca/coop/communit/meccomm/ecofoot.htm).

[50] Wackernagel et al., 1999. See footnote 5.

health, high levels of education, and seemingly sustained growth in its manufactured capital and even natural capital stocks. By most standard measures and criteria, this society would represent the essence of sustainability. If local gains in natural, economic, or social capital accumulation, however, come at the expense of accelerating ecological damage and social disintegration elsewhere, then local prosperity comes at a cost to global sustainability.[51]

The same is true in reverse. The accelerated rate of forest harvesting in Nova Scotia and the loss of almost all the old forests in the province, are not the consequence of Nova Scotians' consumption of timber products alone, but of the *global* demand for pulp, paper and other timber products. In this case we are experiencing local impacts of global consumption patterns, just as there are global impacts from our local consumption patterns. In short, ecological footprint analysis enables consumers to assess the impacts of their consumption patterns no matter where those impacts occur. This report therefore addresses the impact of our consumption both locally in Nova Scotia and globally, and thus provides a more complete picture of the consequences of Nova Scotian consumption habits and demands than that to which we are accustomed.

Sustainability requires that human activity remain within the carrying capacity of nature. It was noted earlier that dividing all the biologically productive land and sea on this planet by the human population results in an average of 2.1 hectares per person in the year 2000. It was also noted that setting aside 12% of the ecologically productive land for biodiversity preservation, as recommended by the Bruntland report, shrinks the available bioproductive space per person from 2.1 hectares to just under 1.8 hectares. The ecological footprint can therefore function as a benchmark of sustainability by comparing the actual per capita consumption of a defined population with the global per capita share of 1.8 ha. Consumption in excess of 1.8 ha. per capita implies that a particular population is using resources and services at an unsustainable rate.

This excess consumption in relation to the per capita global area available is called the "global sustainability deficit."[52] The global sustainability deficit, which expresses the ecological footprint area above 1.8 ha., is calculated by subtracting a region's per capita footprint from the available global ecological capacity per capita. If a region's per capita footprint is less than 1.8 ha., then the global sustainability deficit is negative, which is denoted by a plus sign in the tables below (see Tables 1 and 2).

Tables 1 and 2 below show that the lifestyle of the average Nova Scotian, with a footprint of 8.1 ha. per capita, is clearly not sustainable on a global scale, unless we are explicitly willing to allow millions of our fellow global citizens to live in poverty. As noted above, if everyone in the world had an ecological footprint as large as the average Nova Scotian ecological footprint, it would require five planets the size of the Earth to sustain that level of consumption. (Note: the global "availability" estimates in Tables 1 and 2 include a 12% set-aside for preservation of biodiversity, as recommended by the Brundtland Commission, whereas the actual footprint calculations in both tables do not include that set-aside as they are based on actual consumption patterns.)

[51] Rees, William, 2000. Personal communication.
[52] The global sustainability deficit is based on the ecological deficit calculated in *The Ecological Footprint Of Nations* Study. See footnote 8. The concept is also used in the *Living Planet Report 2000.* See footnote 10.

Table 1. Global Sustainability Deficit I, Nova Scotia and Selected Countries[53]

	Footprint [Ha./Cap]	Global Sustainability Deficit [Ha./Cap]
Nova Scotia	8.1	-6.3
Canada	7.7	-5.9
United Arab Emirates	16.0	-14.2
United States	12.2	-10.4
Singapore	12.4	-10.6
Germany	6.3	-4.5
Chile	3.4	-1.6
China	1.8	0
India	1.1	+0.7
Eritrea	0.3	+1.5
Global Average	**2.8**	-1.0
Global Availability	**1.8**	

Source: WWF, 2000. Living Planet Report 2000.

Table 2. Global Sustainability Deficit II, by Region

Region	Footprint [Ha./Cap]	Global Sustainability Deficit [Ha./Cap]
North America	11.8	-10.0
Western Europe	6.3	-4.5
Central and Eastern Europe	4.9	-3.1
Middle East and Central Asia	2.7	-0.9
Latin America and Central Asia	2.5	-0.7
Asia/Pacific	1.8	0
Africa	1.3	+0.5
OECD	7.2	-5.4
Non-OECD	1.8	0
Global Average	**2.8**	-1.0
Global Availability	**1.8**	

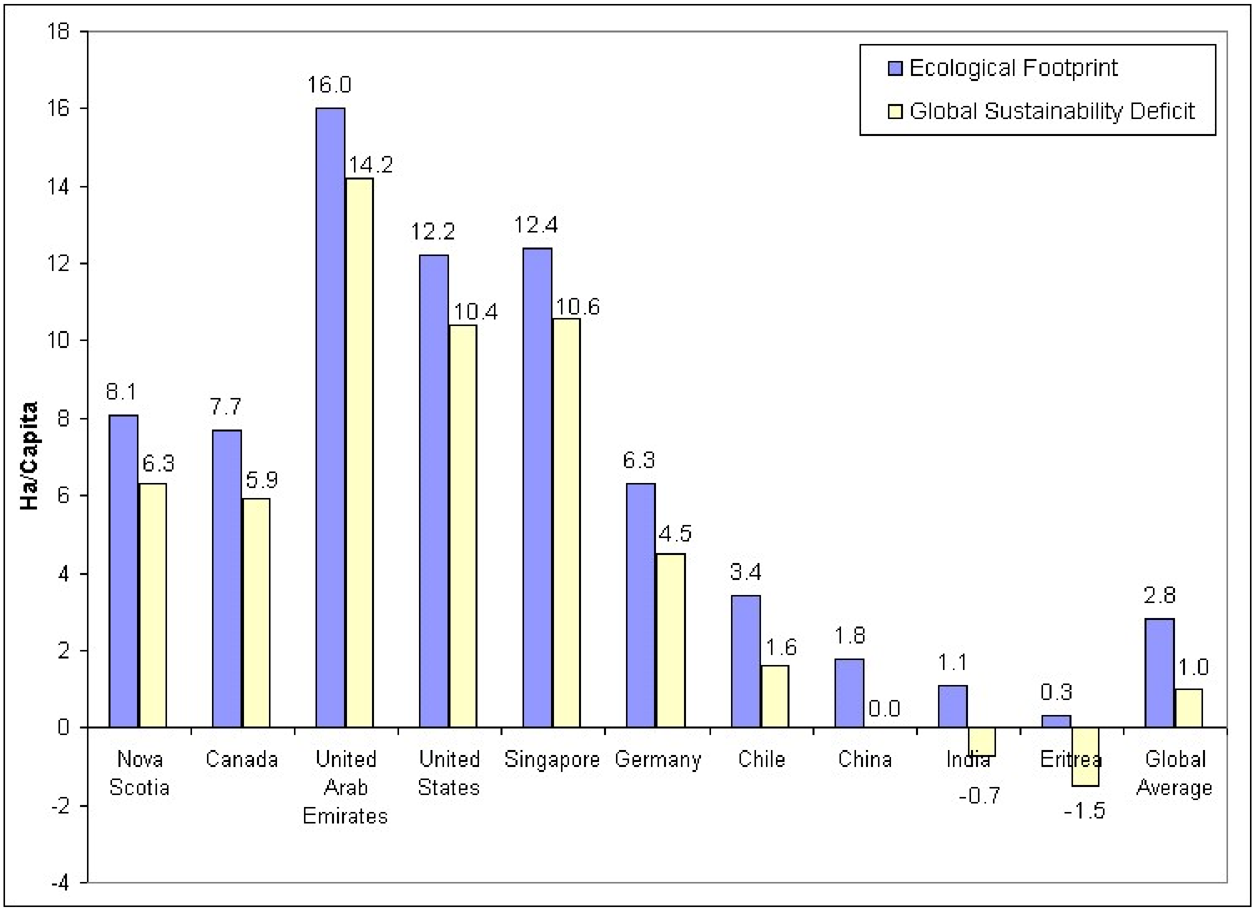
Source: WWF, 2000. Living Planet Report 2000.

As seen in Table 1, Nova Scotia and Canada have a footprint size significantly greater than the 1.8 ha. available per person that would ensure global sustainability. Nova Scotia, in fact, has a

[53] Ecological footprint figures in Tables 1 and 2, with the exception of the Nova Scotia ecological footprint, are from the *Living Planet Report 2000.* See footnote 10. The ecological footprint figures do not include space set aside to preserve biodiversity because they represent actual consumption patterns. The global footprint target (or available land and sea area), however, assumes that 12% of ecologically productive space is set aside to preserve biodiversity, as recommended by the Brundtland Commission. In other words, the "availability" figure represents a target that accounts for the necessity to preserve biodiversity.

global sustainability deficit of 6.3 ha. per capita. In other words, Nova Scotians are consuming resources at a rate that is 4.5 times greater than what is sustainable from a global perspective.

Figure 6. Global Sustainability Deficit I



Source: WWF, 2000. Living Planet Report 2000.

Protected Areas In Nova Scotia: Some Questions for Nova Scotians

A February 1999 Environics poll found that Atlantic Canadians place a high priority on wildlife and habitat values.[54] The poll concluded that people residing in the Atlantic region are among the most concerned about wildlife and habitat protection in the country.

In Nova Scotia, however, only 8.3% of the province's total land area is currently under protection, according to international standards.[55]

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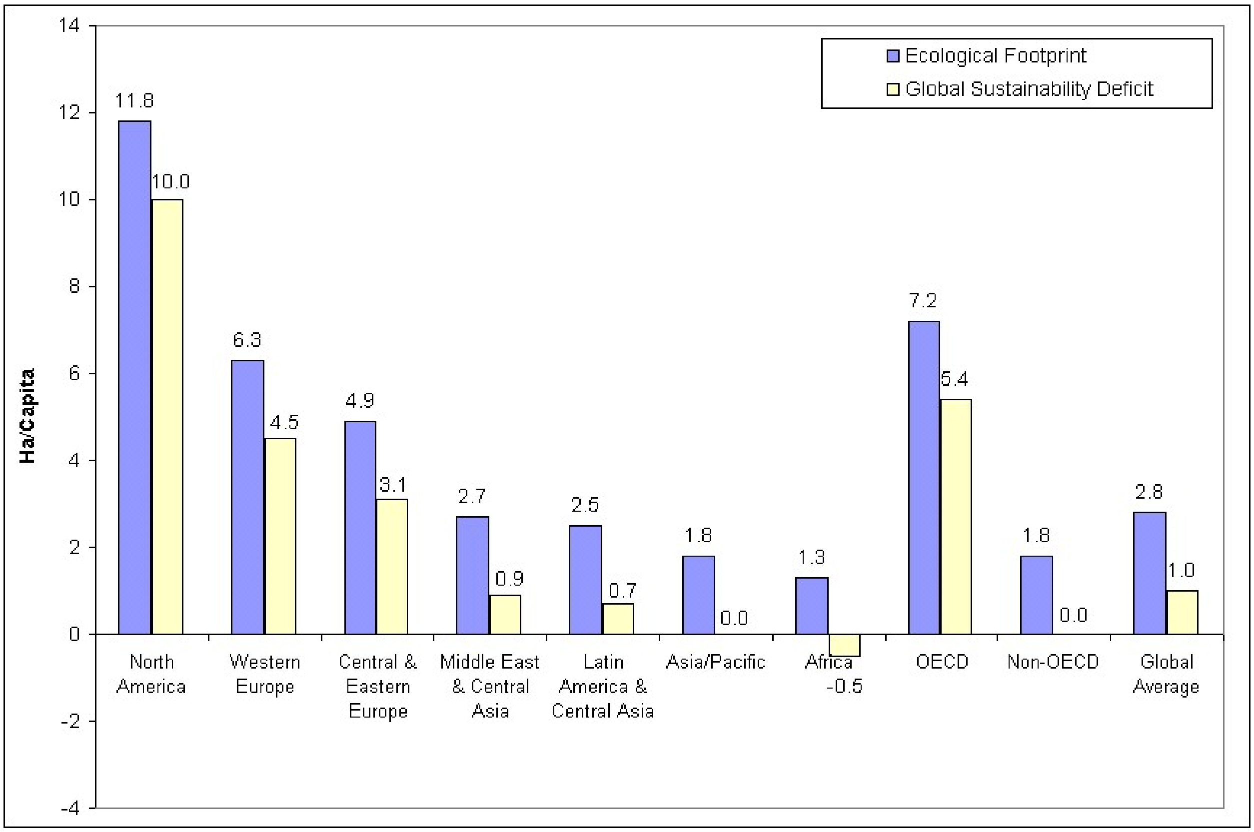
[54] Environment Canada, 1999. Public Opinion & the Environment 1999: Biodiversity Issues. Environics International.

[55] DeGooyer, Kermit, (2001). Personal communication, The Ecology Action Center. All provincial governments have signed the Endangered Spaces Campaign, a World Wildlife Fund initiative to ensure the completion of a network of all Canada's terrestrial regions to be protected by the start of the new millennium. The goal of the campaign, agreed to by all governments, is to ensure that none of Canada's designated landscape and habitat types

- How much land area should Nova Scotians set aside for protection?
- Why hasn't Nova Scotia met its 12% target outlined in the Sustainable Development Strategy for Nova Scotia.[56]
- Is the 12% minimum set-aside recommended by the Brundtland Commission really enough to maintain biodiversity and ecosystem health?
- In a province that is well-endowed with natural spaces, do we have an obligation to protect more?

For more information visit the Ecology Action Center Web Site www.supercity.ns.ca/~land/topics.html and see the Nova Scotia Genuine Progress Index Forest Accounts, available at www.gpiatlantic.org

Figure 7. Global Sustainability Deficit II



become extinct. The Nova Scotia government reaffirmed this commitment in the National Forest Strategy (1998), Commitment 1.6: "We will… work toward completing, by the year 2000, a network of protected areas representative of Canada's forest ecosystem classification categories, to provide ecological benchmarks, protect areas of unique biological value and manage for the continuation of old-growth forest landscapes as natural heritage." For a list of Nova Scotia's protected area commitments, and for more information including an interactive map highlighting Nova Scotia's endangered wilderness hotspots, see the Ecology Action Center web site www.supercity.ns.ca/~land/topics.html. Presently in Nova Scotia only 23 of 80 regions have been afforded a "satisfactory" level of protection (Ecology Action Center Web site, 2001).

[56] *Sustainable Development Strategy for Nova Scotia (1992)*: Proposed Initiative 3.3: "Complete a network of protected areas adequately representing each of the province's theme regions by the year 2000… We suggest a goal of 12 per cent of land and water for protection. All existing old growth forests will be included in this 12 per cent." See The Ecology Action Center web site, www.supercity.ns.ca/~land/commitments.htm.

6. How Does Nova Scotia Compare to Canada?

Nova Scotia's ecological footprint of 8.1 ha. per person is 5% larger than the Canadian ecological footprint of 7.7 ha. per person.[57] Figures 8 and 9 show that Nova Scotians have a smaller per capita food footprint, other crop footprint, built area footprint, and timber footprint than the Canadian average. However, because of a larger energy footprint, Nova Scotians have a greater overall per person ecological footprint than the Canadian average.

As indicated in Table 3, Nova Scotia's per capita and per household income, per capita and per household consumption, per capita energy use, and per capita greenhouse gas emissions are all less than the Canadian averages. Yet Nova Scotia's per capita ecological footprint is slightly larger, because of differences in the energy footprint discussed below.

Figure 8. Nova Scotia/Canada Summary

Canada

Footprint Area	Total [ha/cap]	Equivalence Factor	Equivalent Total [ha/cap]
Food Footprint			
total arable land	0.54	3.16	1.70
total pasture land	2.07	0.39	0.80
total sea	0.97	0.06	0.06
total food footprint	3.58		2.56
Other Crop Footprint			
total arable land	0.01	3.16	0.03
total pasture land	0.09	0.39	0.04
total other crop footprint	0.10		0.06
Energy Footprint			
CO_2 Absorption land	2.04	1.78	3.62
Built Up Footprint			
Built area land	0.13	3.16	0.40
Timber Footprint			
Forest Land	0.59	1.78	1.05
Ecological Footprint			**7.68**

Nova Scotia

Footprint Area	Total [ha/cap]	Equivalence Factor	Equivalent Total [ha/cap]
Food Footprint			
total arable land	0.50	3.16	1.58
total pasture land	2.03	0.39	0.78
total sea	1.13	0.06	0.07
total food footprint	3.66		2.44
Other Crop Footprint			
total arable land	0.01	3.16	0.02
total pasture land	0.08	0.39	0.03
total other crop footprint	0.08		0.05
Energy Footprint			
CO_2 Absorption land	2.40	1.78	4.27
Built Up Footprint			
Built area land	0.11	3.16	0.35
Timber Footprint			
Forest Land	0.53	1.78	0.94
Ecological Footprint			**8.05**

Note: Equivalence factors scale the different land categories in proportion to their productivities. Equivalence factors used in this report are the same as those used in Mathis Wackernagel's 1996 Ecological Footprint study and are consistent with the equivalence factors used in the *Living Planet Report 2000*. Equivalence factors are based on the difference in yields of different land types.

[57] The estimate uses 1996 as the base year for comparison to Mathis Wackernagel's Canadian footprint estimate. 1996 footprint - Nova Scotia = 8.1 ha./capita; Canada = 7.7 ha./capita. 1996 footprint including 12% set aside for biodiversity – Nova Scotia = 9.2 ha./capita; Canada = 8.7 ha./capita. Mathis Wackernagel's 1996 Canadian Footprint estimate was included as part of the *Living Planet Report 2000*. See footnote 10.

Figure 9. Ecological Footprint Comparison Chart

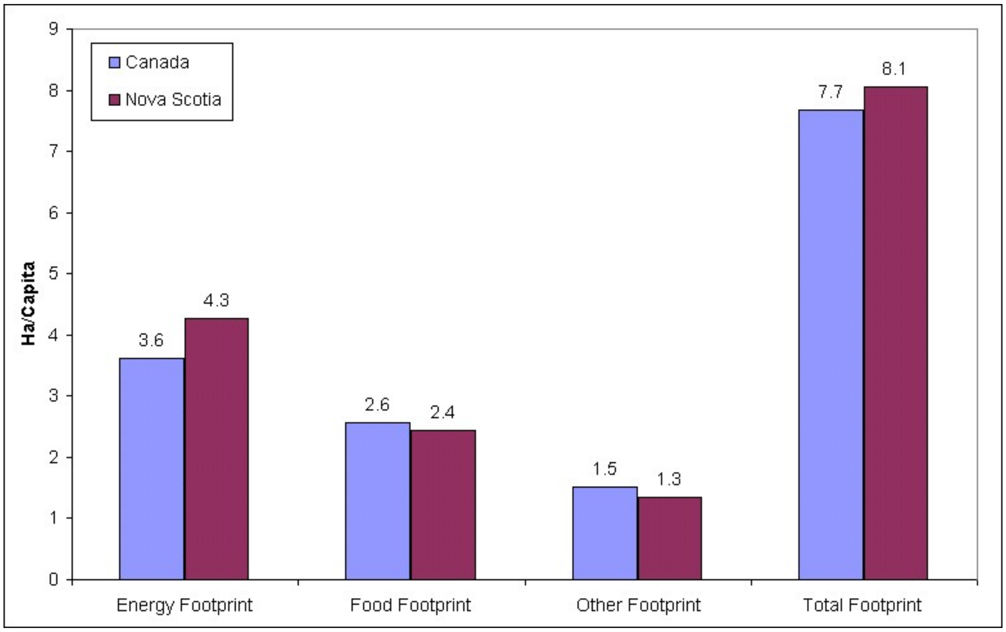


Table 3. Nova Scotia and Canada: Income, Consumption and Footprint[58]

	Nova Scotia	Canada	Nova Scotia vs. Canada
Income per person	$20,480	$24,246	16% less
Disposable income per person	$15,808	$18,245	13% less
Consumption per household	$32,886	$37,713	13% less
Consumption per person	$12,846	$14,505	11% less
Per capita energy use (GJ/yr)	211 GJ	219 GJ	4% less
CO_2 equivalent emissions per capita	21.4 tons	22.7 tons	6% less
Vehicles per capita	0.59	0.59	equal
Ecological Footprint	8.1 ha./cap	7.7 ha./cap	5% more

Sources: Statistics Canada, 1998. *Provincial Economic Accounts, Annual Estimates*; Statistics Canada, 2000. *Canadian Statistics: Families, Households and Housing*; Statistics Canada, 2000. *Estimates of population, by age group and sex, Canada, provinces and territories, annual*; Mathis Wackernagel, 1996. Ecological footprint energy consumption figures from *Energy Information Administration, International Energy Database, May 1999*; and Walker, 2000. GPI Atlantic, *GPI Greenhouse Gas Accounts*.

[58] For each of the categories in Table 3, the most recent available data were used:
Personal income and disposable income: Statistics Canada, 1998. *Provincial Economic Accounts, Annual Estimates, 1998,*Table 17. "Selected Economic Indicators." 1998 year used.
Consumption information: Statistics Canada, 2000. *Canadian Statistics, Families, Households and Housing*. Available at: www.statcan.ca. 1999 year used.
1999 population figures: Statistics Canada, 2000. Cansim II, Table 051-0001 - *Estimates of population, by age group and sex, Canada, provinces and territories, annual.*
Per capita yearly energy consumption: Based on Mathis Wackernagel 1996 Ecological Footprint Energy Consumption figures from Energy Information Administration, International Energy Database, May 1999. The Canadian spreadsheet is available at www.rprogress.org.
CO_2 equivalent emissions per capita: Walker, Sally, 2001 (forthcoming). *GPI Atlantic Greenhouse Gas Accounts*. For more information on the GPI Greenhouse Gas Accounts, please visit www.gpiatlantic.org.

Why does Nova Scotia have a bigger footprint, despite lower consumption per capita than Canada?

If, as stated earlier, the ecological footprint is largely a consumption issue (per capita average consumption in Nova Scotia is more than 10% lower than the Canadian average), why is the average Nova Scotian ecological footprint larger than the average Canadian ecological footprint?

In addition to overall quantity of consumption, two other very important consumption and production patterns affect the size of a region's ecological footprint:

- *What* is being consumed?
- Which *technologies* are in use?

What is being consumed?

When we make a consumption choice, alternative forms of the product or service being consumed often exist which may have differential environmental impacts and thus increase or decrease an ecological footprint. For example, coal is much more energy intensive than hydroelectricity; organic and locally grown foods are less degrading to nature and less energy-intensive than foods imported and transported from far distances and grown with large chemical and energy inputs such as fertilizers and pesticides. There are also fuel efficient car models, alternative transportation options, and energy saving household appliances on the market that allow reductions in a household's energy footprint. Choosing to live in a single detached home as opposed to a home in a multiple unit complex, and making choices such as turning the heat down at night or insulating the attic can significantly affect household energy use. Consumption "choices" therefore influence the impact that our levels of consumption have on our overall ecological footprint.

These choices are even more significant at a societal level. For example public investment in mass transit and integrated land use / transportation planning, rather than public dollars spent on roads and highway construction, can substantially reduce a society's transportation footprint. Thus, planning policies that encourage the revitalization of urban centers rather than policies that encourage suburban and ex-urban sprawl can have a significant impact on footprint size. In fact, without such "societal" choices to support more sustainable household consumption practices, it becomes difficult for households to reduce their footprint to sustainable levels. Existing patterns of automobile dependence, urban sprawl, dependence on non-renewable energy sources, and reliance on imported foods and consumer items hamper even the most dedicated individual efforts to reduce our personal ecological footprint.

Technologies in use

Similarly, different technologies can substantially influence footprint size, beyond what might be indicated by a simple societal comparison of per capita consumption. The level and type of technology used in food production, wood harvesting, building design and manufacturing will help determine a population's footprint size. Energy, for example, can be derived from petroleum, coal, natural gas, windmills, biomass, solar panels or fuel cells, all of which have very different impacts on the environment. Denmark's increasing reliance on wind energy will reduce that country's ecological footprint even if total energy consumption does not drop.

Nova Scotian and Canadian Energy Sources

The single largest factor influencing Nova Scotia's ecological footprint size compared to that of Canada is the source of energy used in Nova Scotia. Although Nova Scotians consume 4% less energy than the Canadian average, the Nova Scotia per person energy footprint is 18% greater. The explanation for this is Nova Scotia's heavy dependence on coal and petroleum based products, both of which have a more substantial impact on the environment than hydroelectricity, for example.

89.2% of electricity in Nova Scotia is derived from coal or oil while only 32.2% of the electricity used in Canada as a whole is derived from coal or oil.[59] Whereas hydroelectricity is a common source of energy in the rest of Canada, only 10% of electricity generated in Nova Scotia comes from small-scale hydro plants. The ecological footprint for 100 Gigajoules per year of energy derived from petroleum-based fossil fuels is more than 1.0 hectare compared to just 0.1 hectare for the same amount of hydroelectricity (Table 4).

Table 4. Footprint Conversion Ratios for Fuel Source[60]

Energy Type	Gj [ha/cap] ratio
Coal consumption	0.0178
Liquid fossil fuel consumption	0.0137
Fossil gas consumption	0.0105
Nuclear energy consumption (thermal)	0.0137
Energy embodied in net imported goods	0.0137
Hydro-electricity consumption	0.0010

Source: Wackernagel and Rees, 1996. Our Ecological Footprint: Reducing Human Impact on the Earth.

While not nearly as dramatic as the differential environmental impact of energy derived from liquid fossil fuel and hydroelectricity consumption (a 14:1 ratio), the forthcoming shift to natural gas in Nova Scotia will nonetheless reduce the province's energy footprint by reducing the current reliance on coal and oil. The footprint (differential environmental impact) ratio of coal to

[59] **NS**: 79.5% coal and 9.7% oil; **CAN**: 29% coal and 3.2% oil . About 10% of electricity in Nova Scotia is generated through small-scale hydro plants. National Energy Board, 1999. *Sectoral energy use breakdown from Canadian Energy, Supply And Demand to 2025.* Available at: www.neb.gc.ca/energy/sd99/index.htm.

[60] Footprint conversion ratios for fuel source are from the 1996 Canadian Ecological Footprint. The footprint conversion ratios are based on the land required to sequester the carbon emitted by the fuel source and on the built-up land required to support the energy type. Further explanation of the footprint conversion ratios are available in Wackernagel and Rees, 1996 (footnote 4).

natural gas is 1.7:1, and the footprint ratio of oil to natural gas is 1.3:1. Thus, natural gas is about 40% less footprint-intensive than coal and 23% less footprint-intensive than oil.

It is also clear that the conversion to natural gas will not reduce Nova Scotia's ecological footprint nearly as dramatically as a switch to renewable energy sources. Solar, wind, biomass, and hydrogen fuel cell energy have virtually no ecological footprint. National Energy Board projections show, however, that the use of renewable energy as a percentage of overall end use energy consumption is expected to increase only marginally from 10.8% in 1996 to 13.2% in 2025 (see Table 5).[61]

Table 5. Projected Renewable Energy Use for Atlantic Canada

	1996	2000	2005	2010	2015	2020	2025
Steam	4.8PJ	4.1 PJ	3.1 PJ	1.9 PJ	2.0 PJ	2.1 PJ	2.0 PJ
Hog Fuel, Pulping Fuel, Wood	66.2 PJ	70.6 PJ	70.7 PJ	71.8 PJ	72.9 PJ	74.2 PJ	74.4 PJ
Solar	-	-	-	-	-	-	-
% of total end use energy consumption	10.8%	11.5%	12.2%	13.2%	13.4%	13.1%	13.2%

Source: National Energy Board, 1999. Canadian Energy Supply and Demand to 2025.

The popularity of wood for space heating in Atlantic Canada, and the use of hog fuel and pulping liquor as energy sources in the pulp and paper industry, account for the relatively large proportion of renewable fuels consumed in the region. Nevertheless, a really dramatic decrease in the energy footprint will require an energy mix that includes a significant increase in renewable energy sources to accompany a substantial decrease in dependency on coal and petroleum.

7. The Halifax Regional Municipality Ecological Footprint

The Halifax regional municipality's ecological footprint is 8.4 hectares per person, slightly larger than the Nova Scotian average footprint of 8.1 ha. per person. The citizens of the HRM require an area of 2.9 million hectares to satisfy current consumption levels. This is over half the area of the entire province and five times larger than the city's political boundaries.[62] Cities are able to prosper by appropriating the carrying capacity of an area vastly larger than the spaces they physically occupy (see Table 6). Cities appropriate the life support functions of distant regions all over the world both through trade and by exploiting the environmental commons.[63, 64]

[61] National Energy Board, 1999. *Canadian Energy, Supply and Demand to 2025,* Chapter 3: "Demand." Appendices available at www.neb.gc.ca/energy/sd99/index.htm.

[62] The geographical area of HRM is 5577.29 km^2 or 10.6% of total area of NS. Schafenburg, Angus. 2000. Personal communication, Halifax Regional Municipality Planning Services Office. The estimated population of HRM in 1996 = 342, 966. Statistics Canada. *Canadian Statistics, People*. Available at: www.statcan.ca.

[63] Folke, Carl., Jansson, Å., Larsson, J. and Costanza, R.1997. "Ecosystem Appropriation by Cities," *Ambio*, Vol. 26, No. 3, 167-172.

Cities can, however, contribute significantly towards the overall sustainability of a region. This is possible because the high-density populations of cities offer the potential for more efficient land use and infrastructure as well as reduced transportation and residential heating requirements. In contrast to the potential footprint savings that cities offer, there tends to be a greater concentration of wealth with a corresponding greater amount of consumption in urban centers which offsets ecological footprint gains due to economies of scale. The Halifax ecological footprint, for example, is 8.4 hectares, 4% larger than the Nova Scotia ecological footprint per person. Halifax's per capita consumption, however, exceeds the provincial average by 11%, so there has been some ecological offset produced by the efficiencies of higher density living.

Table 6. Ecological Footprint of Cities[65]

Region	Area Occupied By Population	Land Area Required To Sustain Population
HRM	5,580 km^2	5 times area of city
Toronto	630 km^2	287 times area of city
London, England	1,580 km^2	125 times area of city
Santiago, Chile	900 km^{2} *	300 times area of city
Largest 29 cities of Baltic Europe	1% of Baltic Sea drainage basin	75% to 1.5 times the whole Baltic Sea drainage area

* Santiago metropolitan area contains 791,581 ha. of which 701,619 ha. are ecologically protected and not occupied by the population. Therefore the ecological footprint is assessed only for the non-protected portion of Santiago.

Sources: HRM: Schafenburg, 2000. Personal communication; Statistics Canada, 2000, *Family Expenditure in Canada*; Statistics Canada, 2000. *Canadian Statistics, Households*; Toronto: Lawrence et al., 1998. *How Big Is Toronto's Ecological Footprint?*; London: Green Channel, 2000. *Reducing London's Ecological Footprint*; Santiago: Wackernagel, 1998. *The Ecological Footprint of Santiago de Chile*; Baltic: Folke et al., 1997. *Ecosystem Appropriation by Cities*.

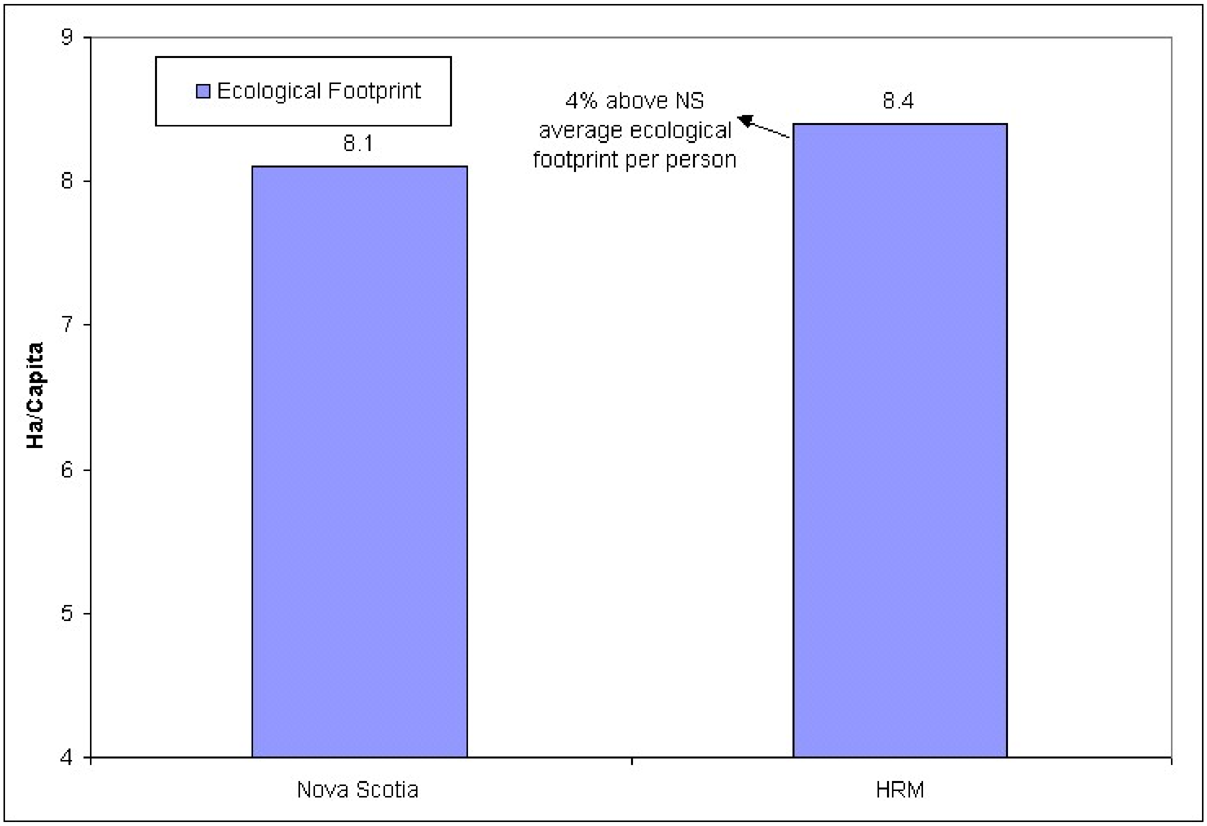
Table 7. Halifax Ecological Footprint and Consumption Expenditure Comparison[66]

	Canada	Nova Scotia	Halifax
Consumption (1999$/Capita)	$14505	$12846	$14255
Ecological Footprint (Ha./Capita)	7.7 ha	8.1 ha	8.4 ha

Source: Consumption expenditures from: Statistics Canada, 2000. *Canadian Statistics, Families, Households and Housing*.

[64] Onisto et al., 1998. See footnote 7.
[65] **HRM:** Schafenburg, Angus. 2000. Personal communication, Halifax Regional Municipality Planning Services Office. The HRM footprint is calculated from income and consumption patterns in Statistics Canada, *Family Expenditure in Canada*, catalogue no. 62-555, and Statistics Canada, 2000. *Canadian Statistics, Households*, Income Statistics Division. Available at: www.statcan.ca.
Toronto: Onisto et al., 1998. See footnote 7.
London: Green Channel, 2000. *Reducing London's Ecological Footprint*. Available at: www.greenchannel.com.
Santiago de Chile: Wackernagel, 1998. See footnote 17.
Largest 29 cities of Baltic Europe: Folke et al., 1997. See footnote 62.
[66] **Consumption expenditure**: Statistics Canada, 2000. *Canadian Statistics, Families, Households and Housing*. Available at: www.statcan.ca. 1999 year used.

Figure 10. Halifax vs. Nova Scotia Ecological Footprint



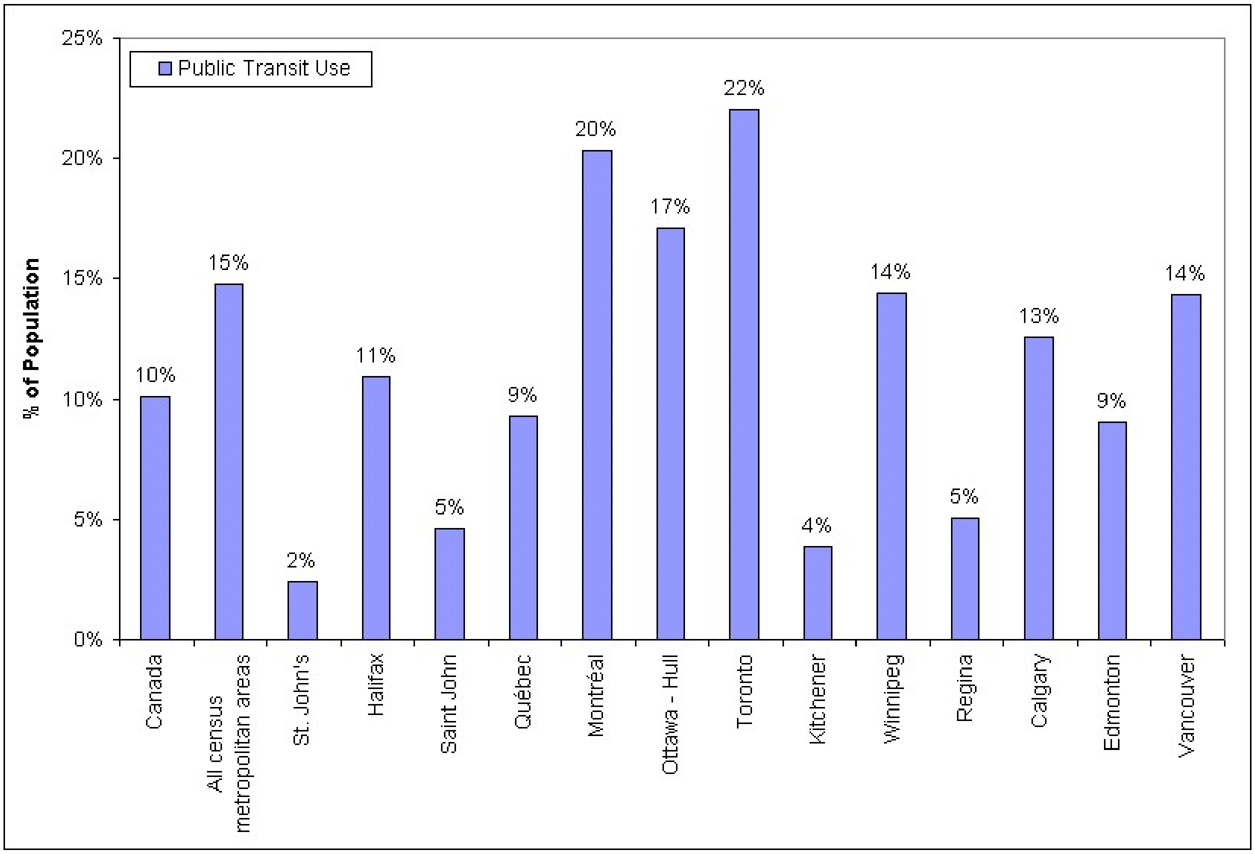
In urban areas, larger populations can more easily support public transportation options. It is also far easier to implement policies that discourage personal vehicle use, such as high occupancy vehicle lanes, high parking costs and user-pay roads. HRM has the greatest access to public transportation in the province, thus offering an alternative to automobile use. As a result of a denser population, there is also greater access to amenities at shorter travel distances. Despite these possibilities, only 11% of Haligonians use public transportation as a mode of transportation to work in comparison to the Canada metropolitan area average of 15% (Figure 11).

High-density housing and typically smaller homes found in urban areas reduce residential energy requirements. Residential energy use, as such, of Haligonians is below the provincial average.[67] The higher density population also makes it easier to implement other sustainability initiatives such as compost and recycling programs that can sharply reduce pressure on landfills.[68]

In short, the economics of scale in urban areas potentially allows considerably smaller ecological footprints than in more rural areas, Unfortunately, the trend towards suburban and ex-urban sprawl in HRM and other urban centers impedes the ability to realize these potential footprint reductions and efficiencies.

[67] Nova Scotia Power. 2000. Available at: www.nspower.ca.
[68] For more information on the ecological footprint of cities please see Rees, William, 1997. "Is Sustainable City An Oxymoron?" *Local Environment,* Vol. 2, p. 303-310.

Figure 11. Metropolitan Area Public Transit Use [69]



Source: Statistics Canada, 1996. *1996 Census Data, Nation Tables*, "Employed Labour Force by Sex, Showing Mode of Transportation to Work, for Census Metropolitan Areas."

8. Not all Nova Scotians Have Equal Footprint Sizes

Not everybody in Nova Scotia has the same footprint size. Although the average footprint is large, there is considerable income disparity in the province, which is reflected in different consumption patterns and footprint sizes. As indicated in Table 8 and Figure 12, the poorest 20% of Nova Scotians have a footprint of 6.2 hectares per person while the wealthiest 20% of Nova Scotians have a footprint of 10.7 hectares per person. This means that the average wealthy Nova Scotian has 1.6 times the impact on the environment that the average low income Nova Scotian does.

Table 8 shows that the average Nova Scotian in the 3rd quintile (40% of the population are poorer, 40% of the population are richer) would spend 13% less on consumption expenditures than the provincial average, resulting in a footprint of 7.0 ha. per person compared to the provincial average of 8.1 ha. per person.

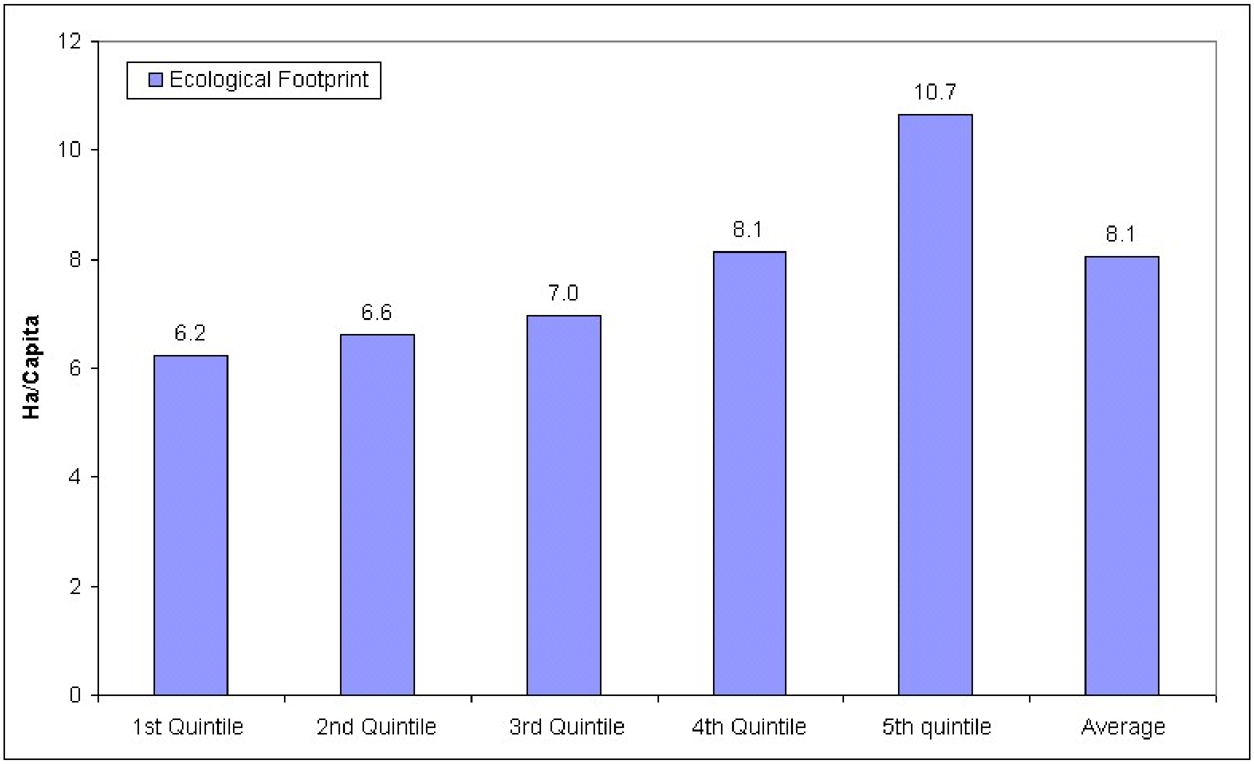
[69] Statistics Canada, 1996. *1996 Census Data, Nation Tables*, "Employed Labour Force by Sex, Showing Mode of Transportation to Work, for Census Metropolitan Areas, 1996 Census." Available at: www.statcan.ca/english/census96/.

Table 8. Ecological Footprint by Quintile, Nova Scotia, 1999[70]

	1st Quintile	2nd Quintile	3rd Quintile	4th Quintile	5th quintile	Average
Consumption Expenditure [$/person]	9,949	10,550	11,131	12,995	17,001	12,846
Ecological Footprint [ha./person]	6.2	6.6	7.0	8.1	10.7	8.1

Sources: Expenditures are from Statistics Canada's consumption expenditure data; methodology for assessing quintile footprint is based on Wackernagel, 1998. *The Ecological Footprint of Santiago de Chile.*

Figure 12. Ecological Footprint by Quintile, Nova Scotia, 1999



Although their footprint is larger, wealthy Nova Scotians, by having greater spending options, have more potential control over consumption choices that affect ecological footprint size. For example, they can afford either large houses on the suburban fringe, which make it necessary to commute long distances, or they can live in urban town-houses near their work, thereby reducing material, transportation and associated energy costs. They can afford to drive sport utility

[70] Footprint estimates by quintile are based on methodology used in Wackernagel, 1998 (see footnote 16). Wackernagel used income distribution data. However the author has derived the Nova Scotia footprint distribution by quintile from consumption expenditure information that is more reflective of an individual's purchasing habits and impact on the environment than income data.

vehicles or they can choose a vehicle that gets high gas mileage, thereby reducing fuel consumption and greenhouse gas emissions. It is clear from Table 8 and Figure 12 that these footprint reduction options are often not exercised.

Many people, however, do have some flexibility in their consumption patterns, which can reduce their ecological footprints. Locally produced food, organically grown vegetables, improved insulation, using energy efficient appliances, and use of bicycles and public transit all produce smaller ecological footprints per dollar spent than the usual alternatives.[71] At the same time, social and political actions can support, encourage and facilitate such choices. For example, investments in mass transit, coordinated land use / transportation planning, and tax incentives for organic farming and renewable energy sources can make ecologically friendly individual initiatives more cost-effective and accessible to all citizens.

9. Ecological Footprint – A 40 Year Perspective

As indicated in Table 9, Nova Scotia's ecological footprint grew between 1961 and 1999 by over 40%, increasing from 5.9 hectares per capita to 8.3 hectares per capita.[72] During the same period the Canadian ecological footprint grew by 60% from 4.9 hectares per capita to 7.8 hectares per capita. The "other footprint" category, representing general purchases and overall consumption levels, experienced the greatest increase between 1961 and 1999 for both Nova Scotia and Canada, 102% and 162% respectively.

Table 9. Percentage Changes in Footprint Size 1999-1961

	Nova Scotia	Canada
Energy Footprint	+ 42%	+ 82%
Food Footprint	+ 17%	+ 15%
Other Footprint	+ 102%	+ 162%
Ecological Footprint	+ 41%	+ 60%

Table 10 and Figures 13 and 14 reveal that the Nova Scotia ecological footprint peaked in 1979 with a footprint of 9.7 hectares per person of which the energy footprint made up 6.0 hectares per capita or 62% of the total ecological footprint per person. The Canadian ecological footprint peaked in 1999 with a footprint of 7.8 hectares per capita including an energy footprint of 3.6 hectares per capita.

[71] Wackernagel and Rees, 1996. See footnote 5.

[72] The ecological footprints for 1997, 1998 and 1999 were calculated by adjusting the 1996 ecological footprint according to the change in per capita consumption between 1996 and each respective year. Detailed spreadsheets are available by contacting GPI *Atlantic* at info@gpiatlantic.org.

Table 10. Historical Ecological Footprint Highlights

Nova Scotia

[Ha./Capita]	1961	1999	Smallest footprint		Largest footprint	
Energy Footprint	3.2	4.5	3.2	(1961)	6.0	(1979)
Food Footprint	2.0	2.4	2.0	(1961)	2.6	(1978)
Other Footprint	0.7	1.4	0.7	(1961)	1.4	(1999)
Ecological Footprint	5.9	8.3	5.9	(1961)	9.7	(1979)

Canada

[Ha./Capita]	1961	1999	Smallest Footprint		Largest footprint	
Energy Footprint	1.9	3.6	1.9	(1961)	3.6	(1979)
Food Footprint	2.3	2.6	2.3	(1961)	2.8	(1979)
Other Footprint	0.6	1.6	0.6	(1961)	1.6	(1999)
Ecological Footprint	4.9	7.8	4.9	(1961)	7.8	(1999)

Sources: Based on consumption and population data from Statistics Canada, *Sources and Disposition of Personal Income* and *Estimates of Population.*

Figure 13. Ecological Footprint Time Series, Nova Scotia, 1961-1999

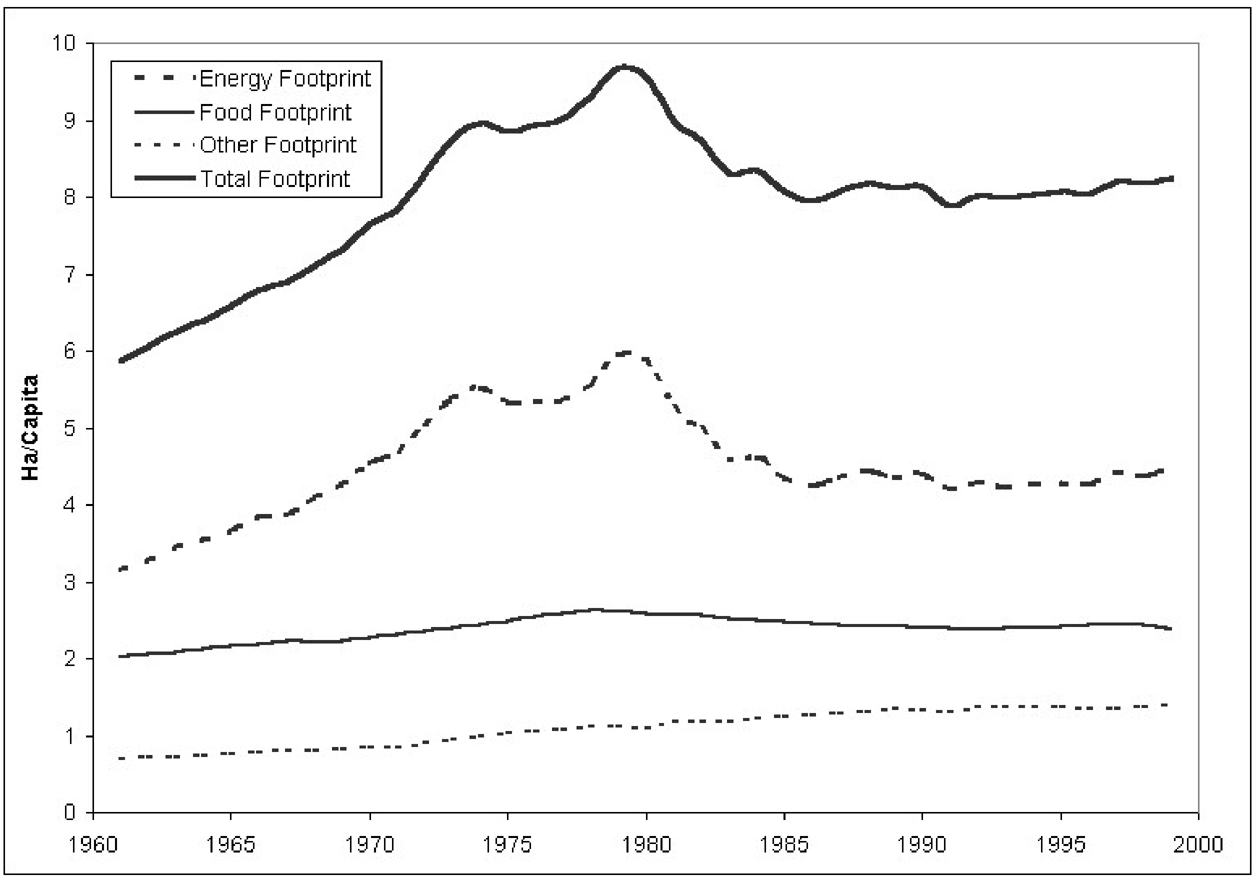
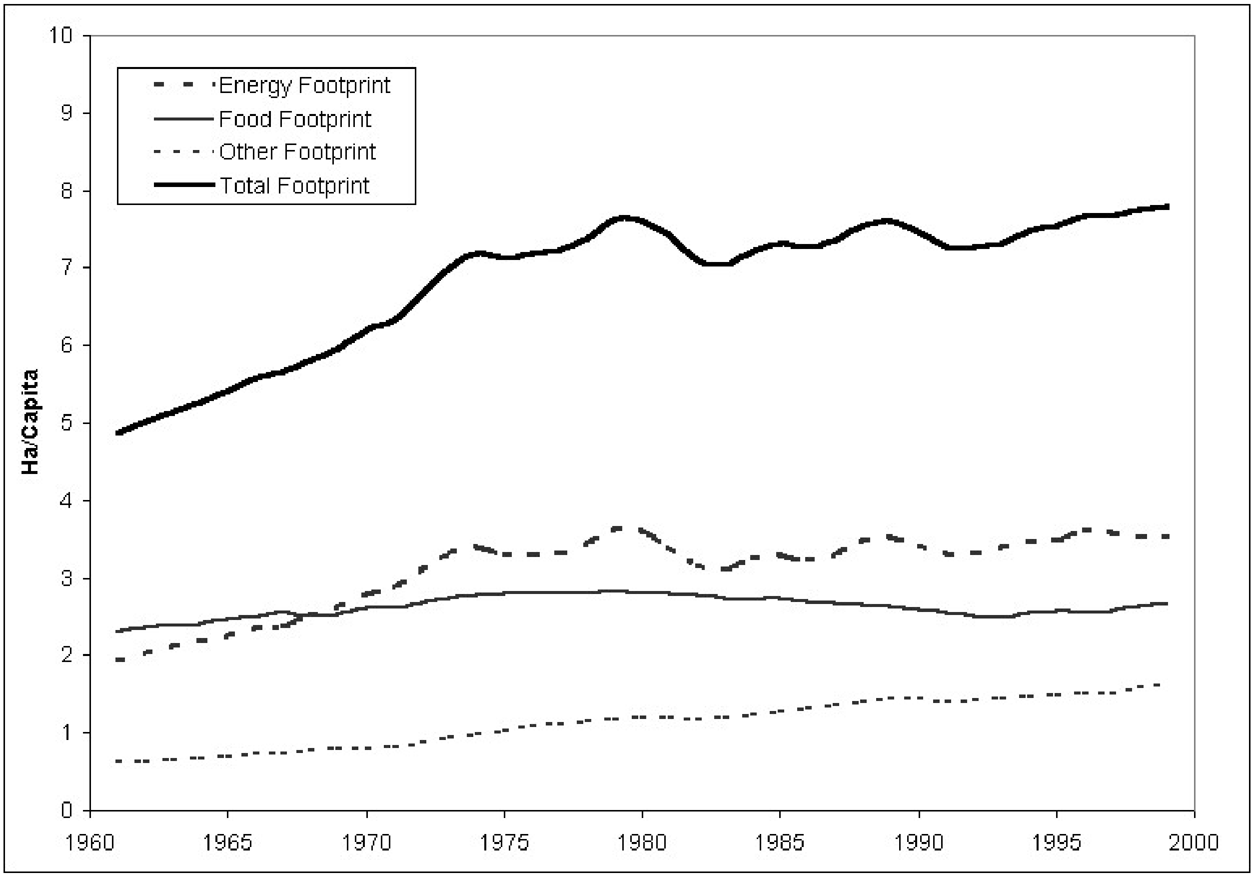


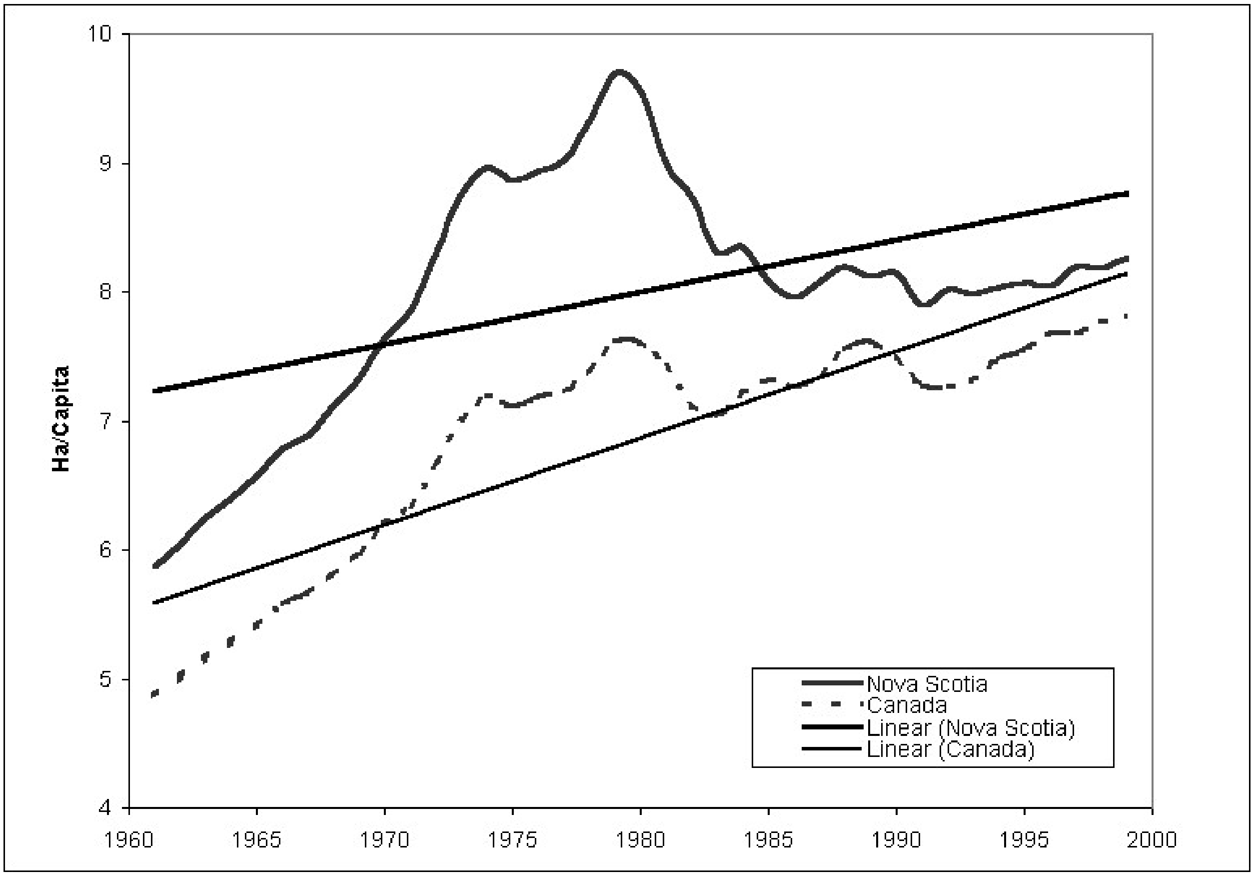
Figure 14. Ecological Footprint Time Series, Canada, 1961-1999



During the early 1980s, the Nova Scotian and Canadian ecological footprint sizes decreased from peaks in 1979 primarily due to higher energy prices, improved energy efficiency, more fuel-efficient automobiles, improved building materials and insulation, and other conservation measures. As well, the recession of the early 1980s reduced consumption spending. Nova Scotia, in particular, sharply reduced its energy footprint in the 1980s. Increased consumption of energy and consumer goods in Canada in the 1990s, however, has outstripped the nation's early energy efficiency gains. While Nova Scotians' average ecological footprint still remains approximately 15% below its 1979 peak, it is starting to angle upward again as we begin the new millennium.

Although the average Nova Scotia ecological footprint per person has been larger than the average Canadian ecological footprint per person since 1960 due to the province's greater reliance on coal and oil, the gap between the two has decreased dramatically from a 26% difference in 1980 to a 6% difference in 1999 (Figure 15).

Figure 15. Ecological Footprint, Nova Scotia and Canada, 1961-1999



10. An Expanding Ecological Footprint

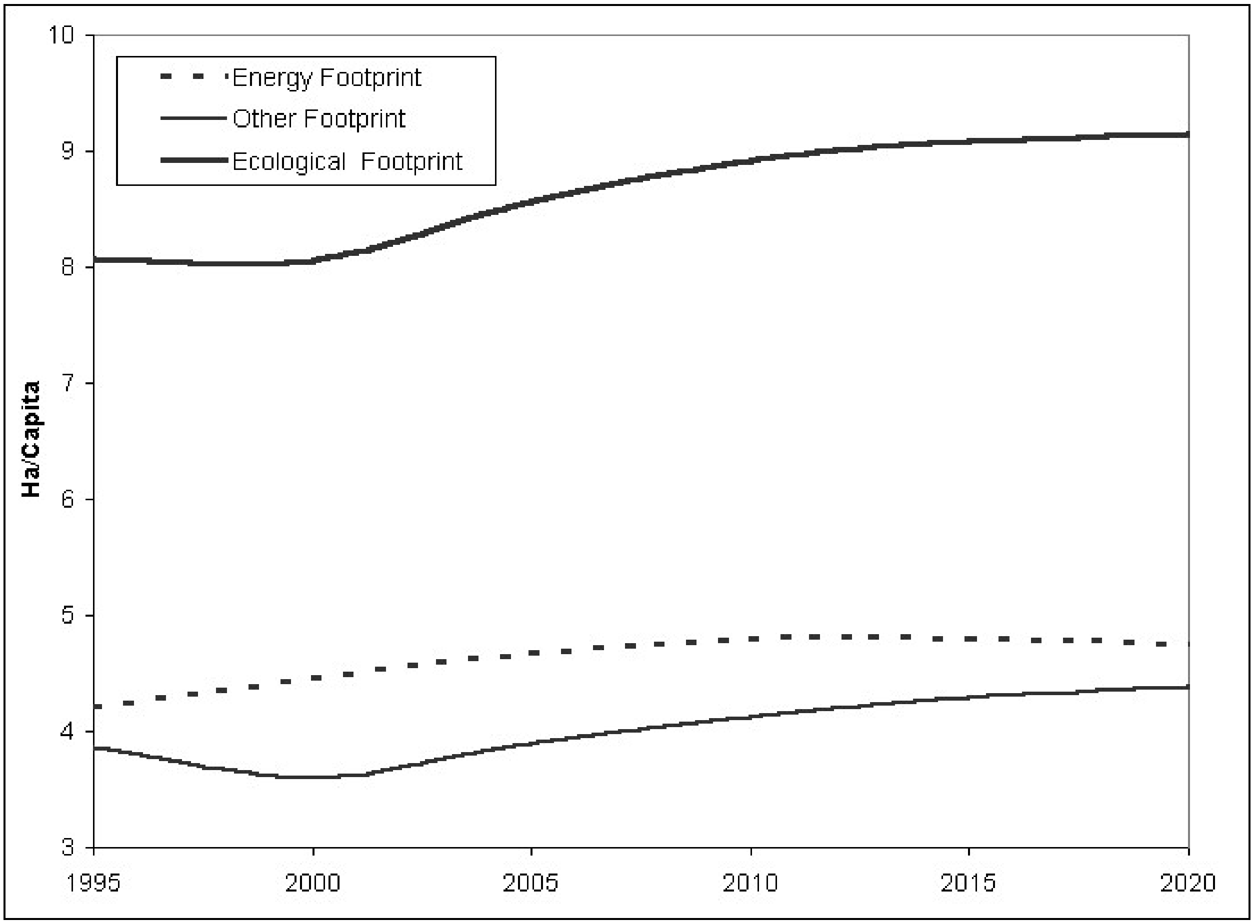
The Nova Scotia ecological footprint will continue to increase unless there is a significant commitment to a sustainable future and major changes both in our personal choices and in social and political decision-making patterns. Based on energy use, consumption and population forecasts derived from current trends, the Nova Scotia per capita footprint will swell by an additional 12% to 9.2 hectares per capita during the next 20 years.[73,74,75,76] Figure 16 shows that, while the province's energy footprint will stabilize due to natural gas conversion, consumption of goods and services is expected to increase sharply.

Although a footprint of 9.2 hectares is by no means sustainable, Nova Scotia's ecological footprint is projected to grow at a slower rate than the Canadian footprint, due primarily to

[73] National Energy Board, 1999. See footnote 58.
[74] Statistics Canada , 1998. *Provincial Economic Accounts, Annual Estimates,* Table 17, Catalogue no. 13-213-PPB.
[75] Natural Resources Canada, 1999. *Canada's Emissions Outlook: 1997-2020.* Available at: www.nrcan.gc.ca/es/ceo/update.htm.
[76] Statistics Canada, 2000. Cansim II, Table 051-0001 - *Estimates of population, by age group and sex, Canada, provinces and territories, annual.*

slower disposable income and energy consumption growth, and the conversion to natural gas. By 2020 the Canadian ecological footprint is expected to total 9.7 hectares per person, 6% higher than the projected Nova Scotia footprint (Figure 17). These GPI estimates are very conservative compared to other Canadian ecological footprint projections. Studies by Onisto, Krause and Wackernagel (1998) suggest that the Canadian footprint could total 11.8 ha. per capita by 2015, a 33% increase over 1997 levels.[77]

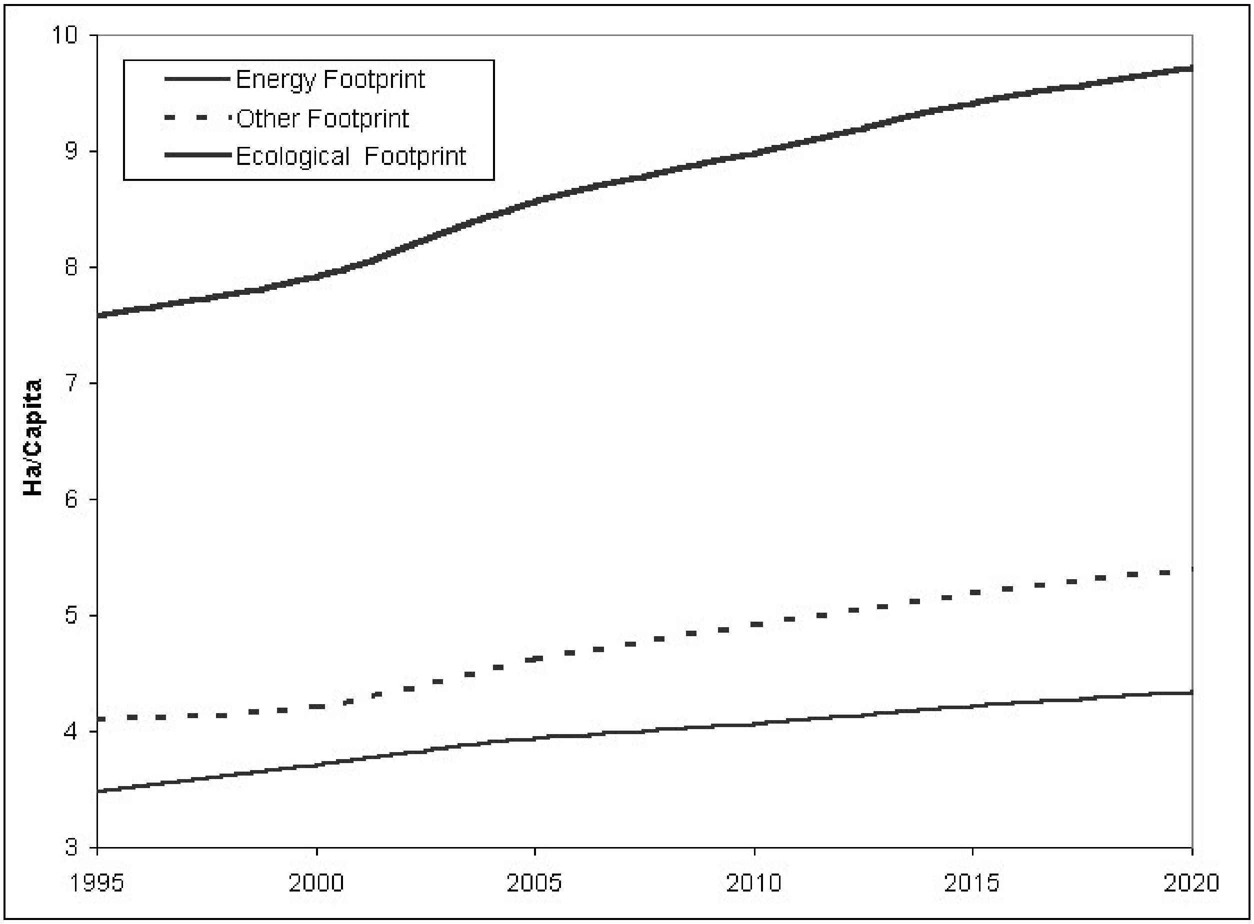
Figure 16. Ecological Footprint Projections, Nova Scotia, 1995-2020



Sources: National Energy Board, Canadian Energy Supply and Demand to 2025; Statistics Canada, Provincial Economic Accounts and Estimates of Population; Natural Resources Canada, Canada's Emissions Outlook: 1997-2020.

[77] Wackernagel et al., 1998. See footnote 6.

Figure 17. Ecological Footprint Projections, Canada, 1995-2020



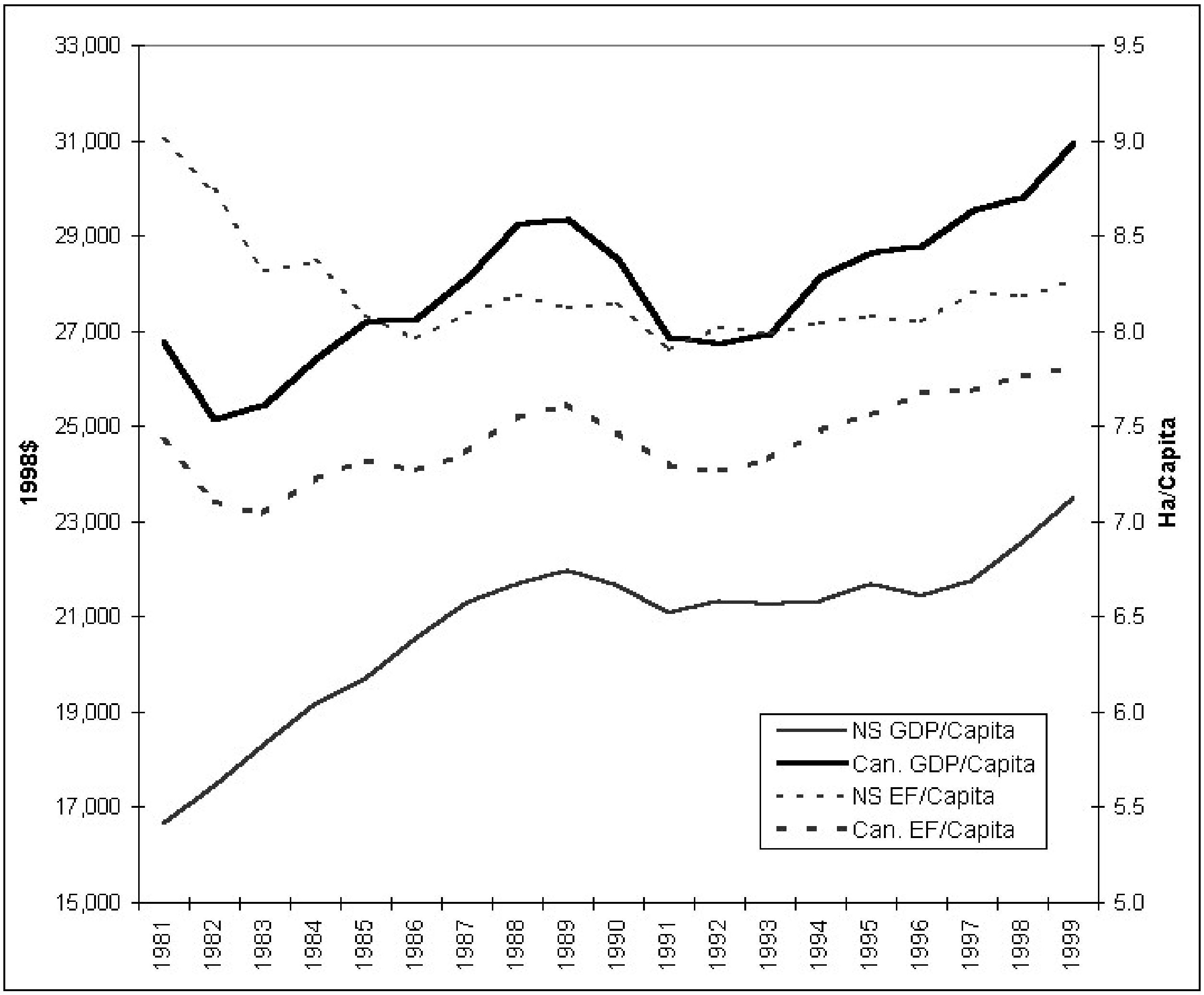
11. Ecological Footprint and GDP

Conventionally, GDP *growth* is taken as the primary indicator of how "well off" we are as a society, with a higher per capita GDP denoting higher consumption levels and greater well-being. From the GPI perspective, on the other hand, a *smaller* ecological footprint denotes less impact on the environment and correspondingly greater long-term well-being and sustainability.

Whether a smaller footprint is indeed a sign of progress clearly depends on each nation's circumstances. In the case of Nova Scotia, with an average footprint of 8.1 ha. per person, a smaller footprint is essential to sustainability and to ensure the well-being of future generations. On the other hand, many countries with exceptionally small footprints, such as Eritrea and Bangladesh, will be able to increase both per capita GDP and their ecological footprints in order to secure basic human needs without exceeding the 1.8 ha. per person ecological "bottom line." As indicated earlier, in a world of finite resources, large footprints by some impose smaller footprints upon others, so the paths to sustainability are correspondingly different.

The GDP and the ecological footprint, however, are not simply *separate* indicator sets pointing towards contrasting assessment and measurement systems. Economic growth is the primary driver of ecological footprint growth, because it generally denotes higher consumption levels. Not surprisingly, the Canadian per capita GDP and ecological footprint growth rates have virtually paralleled each other in the last two decades (Figure 18). With the exception of the sharp reduction in Nova Scotia's energy footprint in the early 1980s, the Nova Scotia per capita GDP and footprint levels have also followed similar trends, with both inclining upwards through the 1990s.

Figure 18. GDP and Ecological Footprint



Source: Statistics Canada, *Selected Economic Indicators*

The Nova Scotia GDP per person grew 40% between 1981 and 1999 from $16,664 to $23,474.[78] In conventional terms it is almost heresy to suggest that this growth is not inherently a "good"

[78] In 1998 constant $. Statistics Canada, 2000. Cansim 1, matrix 9220-9230: Provinces - Selected Economic Indicators, and Matrix 9219: Canada - Selected Economic Indicators.

thing. Ecological footprint analysis, however, suggests that the more complex relationship between economic growth, increased consumption, environmental degradation, waste production, and the rate of resource depletion must at least be considered if we place as much value on the well-being of our children as we place on our own.

Just as excess spending in the 1970s and 1980s left a massive legacy of debt in the 1990s, so continued growth and consumption today is likely to leave a serious environmental debt that the next generation will be forced to pay. By valuing natural wealth as well as man-made wealth, and by recording natural capital depletion as a cost in the same way that man-made capital depreciates and is used up, the GPI can provide an antidote to the over-simplistic equation of GDP growth with well-being. The suggestive alignment of GDP growth with ecological footprint growth further challenges us to explore alternative ways of enhancing well-being other than by increased material accumulation and consumption.

PART IV
REDUCING OUR ECOLOGICAL FOOTPRINT

Energy and food consumption account for 6.7 hectares per person or 83% of the average Nova Scotian's ecological footprint. It is within these two areas that Nova Scotians can make the greatest reductions in their personal footprint and help lead Nova Scotia toward a healthy, sustainable future. These two areas should also be the primary focus of social and economic policy attention to guide Nova Scotia toward sustainable transportation, land use and consumption patterns.

The energy footprint alone, at 4.3 hectares per person, is almost 2½ times greater than the total global sustainability threshold of 1.8 ha. per global citizen. Within the energy sector, social and personal decisions and actions concerning transportation and household energy use will have the most significant impact both on an individual's personal footprint and on the provincial footprint as a whole.

The following section explores the Nova Scotian transportation footprint, household energy footprint and food footprint separately, and concludes with a "good news" story showing that Nova Scotians have already demonstrated their capacity and willingness to reduce their footprint through a combination of personal actions and enlightened policy. This section proposes concrete actions we can take as individuals and as a society to reduce further the impact of our lifestyles on the Earth and thereby to ensure a more secure future for our children.

12. Transportation Footprint

An Expanding Transportation Footprint

The Nova Scotia average transportation footprint totals an area of 1.6 ha. per person. The transportation footprint consists primarily of direct fossil fuel combustion in driving; indirect carbon consumption for car manufacturing and road maintenance; and the physical built space occupied by roads.

Between 1985 and 1997, total energy demand for road transportation grew by 1.8% per year in the province with average vehicle kilometres traveled (VKT) increasing by 1.4% per year.[79] The National Energy Board's 25-year forecast estimates that energy demand will continue to increase at a rate of 0.6% -1.4 % per year depending on the degree of penetration of fuel-efficient vehicles.[80] Assuming that the transportation footprint increases at the same rate as transportation energy demand, a 1.4% annual increase will result in a transportation energy footprint of 2.4 ha. per person by the year 2025.[81]

As indicated in Table 11, the average Nova Scotian car travelled 19,000 km a year in 1997. It is estimated that this will increase to 22,500 km a year by 2020. Factors contributing to VKT

[79] Secondary Energy Demand refers to end use demand. National Energy Board, 1999. See footnote 58.
[80] National Energy Board, 1999. See footnote 58.
[81] The 1% projected increase used in this calculation is simply the midway point between the energy demand forecast estimates of 0.6-1.4% per year.

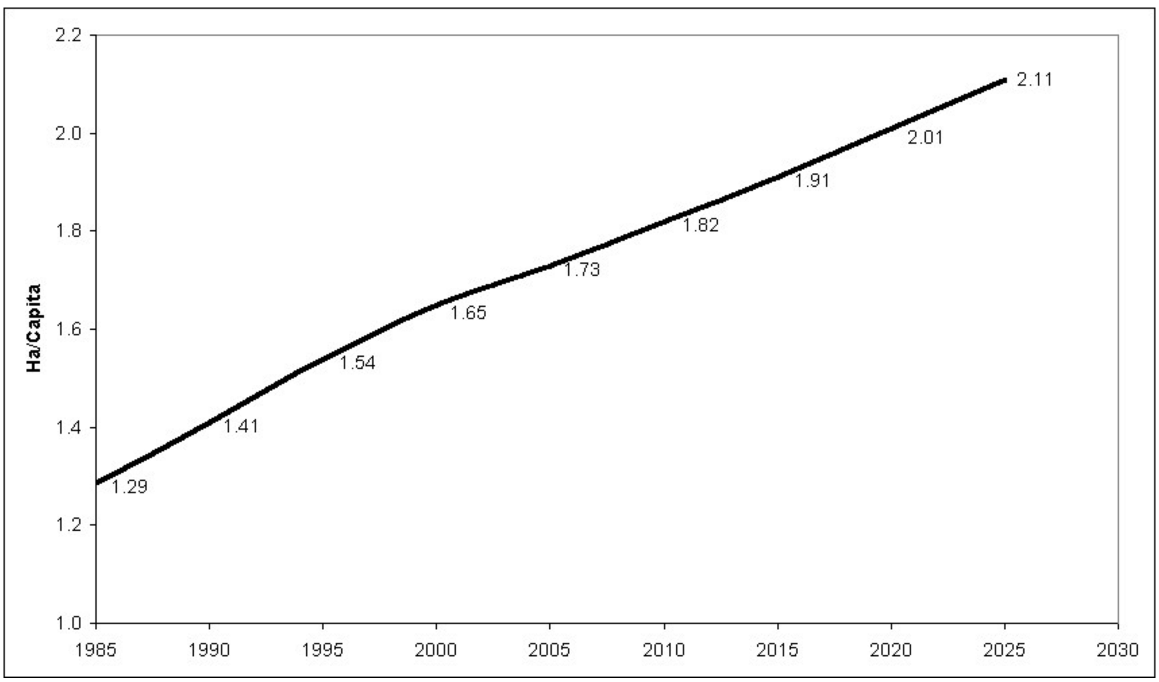
growth include suburban and ex-urban sprawl, longer commutes to the workplace, and an increase in domestic road vacations.[82] Between 1997 and 2020, Natural Resources Canada projects a 15% increase in vehicles in the province, a 4% increase in vehicle kilometres travelled per vehicle, and a 25% increase in transportation energy demand (Table 11). These trends are likely to double the province's transportation footprint in just over 20 years.

Table 11. Transportation Energy Demand, Nova Scotia, 1997-2020[83]

	1997	2020
Passenger Car Stock	309,000 cars	356,000 cars
Vehicle Kilometers Travelled (per vehicle)	19,460 vkt	20,240 vkt
Energy Demand (transportation sector)	2120 Petajoules (PJ)	2651.7 PJ
Transportation Footprint	1.6 ha	1.8-2.2 ha

Sources: Natural Resources Canada. 1999. Canada's Emissions Outlook: An Update, 1997-2020; and National Energy Board. 1999. Canadian Energy: Supply and Demand to 2025.

Figure 19. Estimated Transportation Footprint, Nova Scotia, 1985-2025



Note: Footprint increase assumes a 1.0% annual increase in transportation energy based on National Energy Board forecasts.

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[82] Idem.

[83] **Passenger Car Stock** and **Vehicle Kilometers Traveled**: Natural Resources Canada, 1999. See footnote 84.
Energy Demand: National Energy Board. 1999. See footnote 58.
Transportation energy footprint: Based on assumption that the transportation energy footprint will increase at the same rate as transportation energy demand. The forecasted transportation energy demand is expected to increase at a rate of 0.6-1.4 % per year depending on the degree of penetration of fuel-efficient vehicles. A 0.6% annual increase results in a footprint estimate of 1.8 ha. per person while a 1.4% annual increase results in a footprint estimate of 2.2 ha. per person. National Energy Board. 1999. See footnote 58.

In addition to the burden of increased energy consumption, an increase in VKT and a larger vehicle fleet will have significant impacts on our overall ecological footprint in other ways. This will occur from the need for more road infrastructure and maintenance, increased pollution and waste production, and reduced wildlife habitat. Other more subtle and indirect costs of transportation and automobile dependence, such as reduced community interaction, decreased mobility for non-drivers, and the extra burden placed on the health care system due to road accidents have impacts on our quality of life and community well-being.[84, 85, 86]

How does Nova Scotia Compare to Canada?

Nova Scotians depend heavily on their vehicles, driving over 19,000 km a year per passenger vehicle and spending $6,437 a year per household on transportation costs (Table 12). Nova Scotians on average spending nearly 8% of their waking hours in transit. In comparison to other Canadians, Nova Scotians have the same number of registered vehicles per person, drive slightly fewer kilometers per passenger vehicle but have a greater mean commuting distance to their places of work.

Table 12. Transportation Use, Nova Scotia and Canada[87]

	Nova Scotia	Canada
Motor vehicles registrations per person	0.59	0.59
Vehicle kilometers travelled/passenger vehicle	19,457 km	19,995 km
Amount spent on transportation per household	$6437	$6877
% of household budget spent on transportation	14%	13%
Average time spent on transportation per person*	1.2 hours	1.2 hours
Mean commuting distance to workplace	8.3 km	7 km

* Only Canadian figures are available for transit time estimates. Nova Scotia time estimates are assumed to correspond to the Canadian average, given slightly longer commuting distances and slightly fewer vehicle kilometres travelled. Figures include time spent in an automobile or taking public transit.

Sources: Statistics Canada, 2000, Canadian Statistics. Communications, Transportation, and Trade; Natural Resources Canada, 1999, Canada's Emissions Outlook: An Update, 1997-2020; Statistics Canada, 2000, Canadian Statistics: Families, Households and Housing; and Statistics Canada, 1996. Nation Tables, Commuting Distances.

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84 Burchell, Robert. et al., 1998. *The Costs of Sprawl – Revisited*, TCRP Report 39, Transportation Research Board . Available at: www.nas.edu/trb.

85 Johnson, Elmer. 1993. *Avoiding the Collision of Cities and Cars*, American Academy of Arts and Sciences, Chicago.

86 Appleyard, Donald. 1981. *Livable Streets,* University of California Press, Berkeley.

87 **Motor Vehicle Registrations:** Statistics Canada, 2000. *Canadian Statistics. Communications, Transportation, and Trade*. Available at: www.statcan.ca/english/Pgdb/Economy/Communications/trade14.htm. Most recent figures are 1998 year.
Vehicle Kilometers Traveled/ Passenger Vehicle: Natural Resources Canada, 1999, see footnote 80. Used estimates for year 2000.
Amount spent on transportation per household and **percentage of household budget spent on transportation:** Statistics Canada, 2000. *Canadian Statistics, Families, Households and Housing*. Available at: www.statcan.ca. Most recent figures are 1999 year.
Mean commuting distance to workplace: Statistics Canada, 1996. *Nation Tables*, *Commuting Distances*, catalogue no. 93F0020XCB96004. Available at: www.statcan.ca/english/census96/.

Nova Scotians spend less per household on transportation than the Canadian average, but slightly more when transportation costs are considered as a percentage of the total household budget. Both Nova Scotians and Canadians spend more on transportation than any other expenditure category (including food) with the exception of shelter and taxes.[88] Note that these transportation costs are direct internal costs only and do not include "external" social and environmental costs. The full costs of transportation will examined in the Genuine Progress Index Transportation Accounts.

13. Reducing Our Transportation Footprint

The Footprint of Commuting

In their landmark book *Our Ecological Footprint, Reducing Human Impact on the Earth*, Wackernagel and Rees (1994) estimated the footprint of commuting. A person living 5 km from work requires an extra 122 square meters of ecologically productive land for bicycling, 301 square meters for busing, and 1,442 square meters for driving alone by car. The land for the cyclist is needed to grow extra food, while most of the land needed to support bus passengers and car drivers is used for absorbing CO_2.

Commuting alone by car contributes **12 times** more than cycling and over **4 times** more than taking the bus to our ecological footprint. Table 13 shows how we can reduce our commuting footprint by car-pooling, taking the bus, or cycling, -- one, three, or five days per week.

Table 13. Reduction in Commuting Footprint

Change:	1 day a week	3 days a week	All the time
From 1 person per vehicle to 2	10% reduction	30% reduction	50% reduction
From 1 person per vehicle to 4	15% reduction	45% reduction	75% reduction
From driving alone to taking the bus	16% reduction	47% reduction	79% reduction
From driving to cycling	18% reduction	55% reduction	92% reduction

Note: The reductions in Table 13 are not reductions in the overall ecological footprint, but in the commuting portion of that footprint.

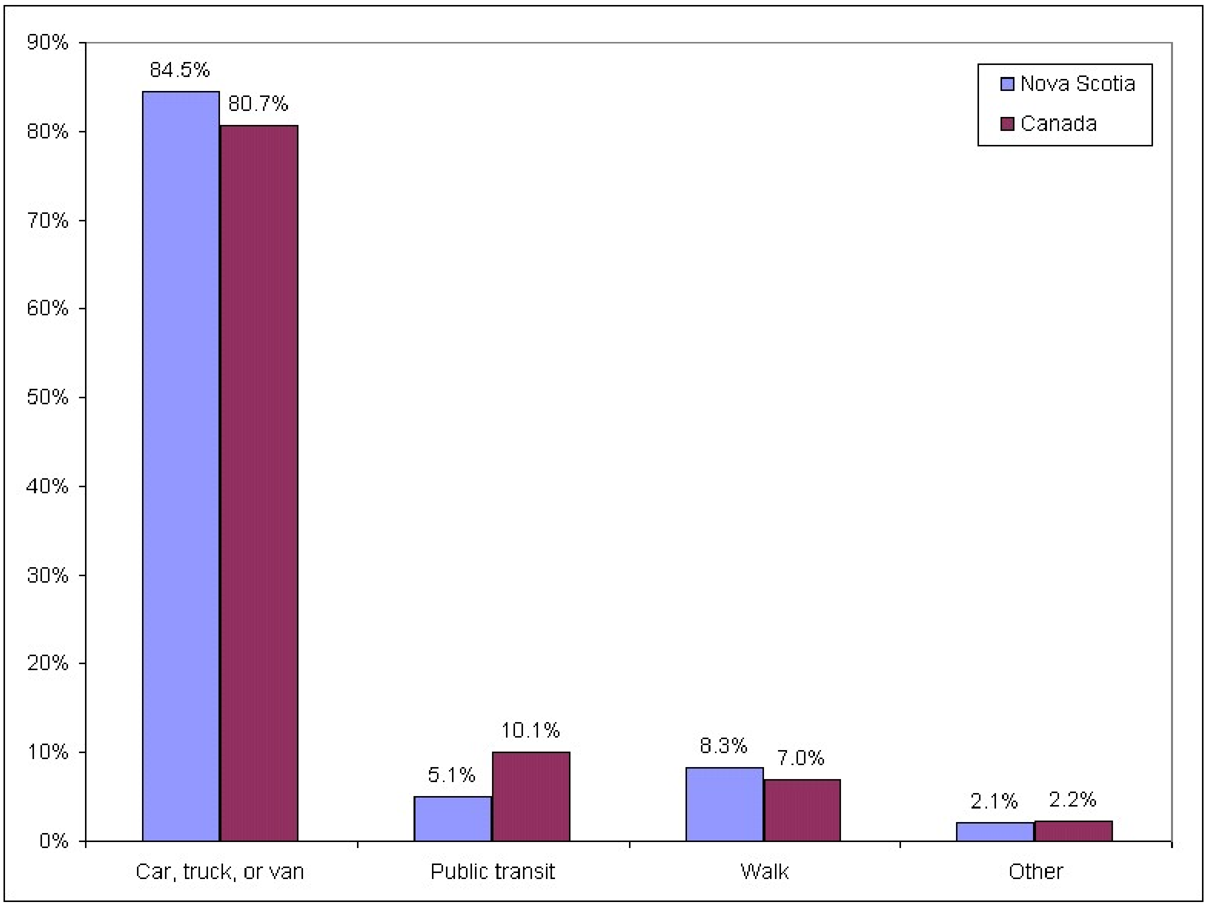
Rethinking how we travel to and from work can dramatically reduce our commuting footprint. For example, a small change like car-pooling once a week with one other person results in a 10% reduction in our commuting footprint. Cycling to work and back every day instead of driving alone corresponds to a 92% reduction in the impact of our commuting habits on the environment.

[88] Nova Scotians household expenditure breakdown: 19% personal income tax, 18% shelter, 14% transportation, 11% food. Canada household expenditure breakdown: 22% personal income tax, 19% shelter, 13% transportation, 11% food. Statistics Canada, 2000. *Canadian Statistics, Families, Households and Housing*. Available at: www.statcan.ca. Most recent figures are 1999 year.

As indicated in Figure 20, 85% of Nova Scotians travel to work by car, truck, or van while only 5% use public transit. The best way to reduce our commuting footprint is to live near our place of work. If this is not an option, car-pooling or taking public transportation can reduce our commuting footprint by up to 79%. The average car in a Canadian city carries 1.3 persons. A standard bus replaces about 50 cars in rush hour.[89]

Addressing commuting habits is especially relevant for Nova Scotians (see Figure 21). Nova Scotian commuters, with a median commuting distance to work of 8.3 km, have the greatest median commuting distance in Canada, over 18% longer than the Canadian average commuting distance to work of 7.0 km. Also, more Nova Scotia commuters travel 20 km or more to work than any other province in Canada, 32% above the Canadian average.

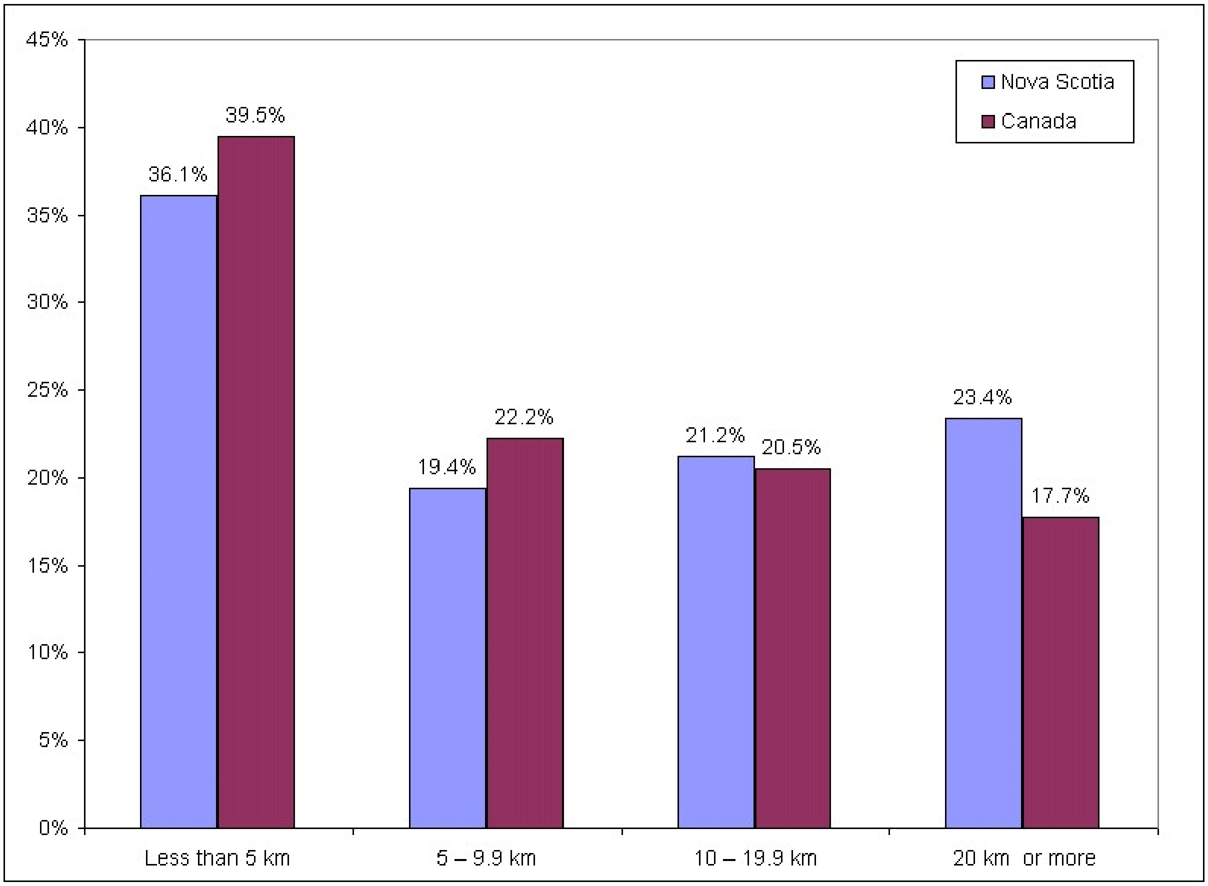
Figure 20. Mode of Transportation to Work, Nova Scotian and Canadian Commuters [90]



Source: Statistics Canada, 1996. Nation Tables: Mode of Transportation to Work.

[89] Adapted from Canadian Urban Transit Association, 1995. *The Environmental Benefits of Urban Transit.*
[90] "Other" includes bicycle, motorcycle, taxicab, and all other modes of transportation. Statistics Canada, 1996. *Nation Tables, Mode of Transportation to Work*, catalogue no. 93F0020XCB96004. Available at: www.statcan.ca/english/census96/.

Figure 21. Commuting Distance of Nova Scotian and Canadian Commuters[91]



Source: Statistics Canada, 1996. *Nation Tables*: *Commuting Distances.*

Concerted policy planning is required to bring about any substantial shift in commuting patterns. To influence how people travel to and from work, it is key that options be made available. Without adequate access to public transit or a safe environment for biking and walking, it will be difficult to encourage individuals to forego driving to the workplace.

A 1998 survey for Go For Green, conducted by Environics International Ltd., indicated that 70% of Canadians would cycle to work if they had access to a dedicated bike lane by which they could get to work in less than 30 minutes.[92] Assuming 5 km as a conservative distance to bicycle in 30 minutes, this indicates that 25% of Nova Scotian commuters would likely be willing to cycle to work if there were more bicycle lanes.[93] Currently, less than 2% of Nova Scotian workers cycle to work (see Figure 20).

[91] Statistics Canada, 1996. *Nation Tables*, *Commuting Distances*, catalogue no. 93F0020XCB96004. Available at: www.statcan.ca/english/census96/.

[92] Environics International Ltd. Sept. 1998. *Go For Green survey: Major Benefits to Health and Environment Seen If Canadians Within 30 Minutes Regularly Cycled or Walked to School.*

[93] 70% (Percentage of Canadians who would cycle to work if they had access to a dedicated bike lane by which they could get to work in less than 30 minutes) x 36% (Percentage of Nova Scotians who commute 5km or less to work) = 25%.

Choosing to walk or cycle to work not only offers environmental benefits but also contributes to better health and lowers health care costs. The Heart and Stroke Foundation reports that 66% of Canadians are not active enough to maintain good health, and that devoting 30 minutes per day to moderate exercise such as walking or cycling has been medically demonstrated to contribute to good health and well-being.[94]

Coordinated land use/transportation planning is essential to turning around current suburban and ex-urban sprawl trends and thereby reducing the Nova Scotia commuting footprint.

Change Our Driving Style

Studies conducted by the European Bureau of the Alliance Internationale de Tourisme and the Federation Internationale de l'Automobile indicate that simple changes to driving style and driver education can bring overall fuel economy savings of up to 15%. That, in turn, can produce a reduction in our transportation footprint, since almost all of that footprint is related to energy consumption and fossil fuel combustion.[95]

Strategies to greener driving recommended by the European Bureau include:

- **Servicing vehicles regularly.** A vehicle that is not properly maintained can increase fuel consumption by 50% and pollution emissions by 20%.
- **Avoiding idling.** Idling for 15 seconds requires more gas than restarting a car.
- **Accelerating and braking smoothly**. Smooth accelerating and braking can bring fuel savings of 10%.
- **Using the correct gears for the speed**. Correct gear use can bring fuel savings of up to 25%.
- **Not carrying unnecessary weight.**
- **Checking tire pressure regularly**. Proper tire pressure can bring fuel savings of up to 3%.
- **Using air conditioning less frequently.**
- **Using a timer that will turn on the block heater just before driving.**[96]

Fuel Efficiency and Vehicle Footprint

The transportation footprint of vehicles is directly related to their fuel efficiency. Most of the environmental impacts associated with motor vehicles are a result of exhaust emissions and the pollution associated with supplying the fuel. The breakdown of lifecycle ("cradle to grave") energy use for a typical automobile reveals that nearly 90% is due to fuel consumption.[97] The U.S. Environmental Protection Agency (EPA) estimates that light vehicles account for

[94] Heart And Stroke Foundation, 2000. *The Changing Face of Heart Disease and Stroke in Canada, 2000.* To obtain this publication and for more information about heart disease and stroke in Canada, visit the web site at www.heartandstroke.ca.
[95] Europe Environment. 1999. *Global Warming: Better Motorists Could Cut Fuel Use and Help Combat Climate Change*, Press Release November 16.
[96] Idem.
[97] American Council for an Energy Efficient Economy, 2001. *Automobiles and the Environment*, February 8, 2001. Available at: www.greenercars.org/news.html.

approximately 40% of all oil consumption and contribute about 20% of all carbon dioxide emissions in that country.[98]

Several web sites provide vehicle fuel efficiency information to help guide consumer product choice, including *The AutoSmart Website* sponsored by Natural Resources Canada at www.autosmart.nrcan.gc.ca/ and the United States Department of Energy web site at www.fueleconomy.gov.[99, 100] Fuel economy and the subsequent impact on the environment vary dramatically from vehicle to vehicle. For example, the model 2001 Honda Insight hybrid vehicle gets 61 miles per gallon (mpg) in city driving and 68 mpg in highway driving with greenhouse gas emissions of 3.1 tons per year based on average vehicle miles travelled.[101] By contrast, the model year 2001 Lincoln Navigator sport utility vehicle (SUV) gets 12 mpg in city driving and 16 mpg in highway driving with greenhouse gas emissions of 14.3 tons per year.[102] On average, **one SUV has about three times the impact on the environment of a small car**.

There is a significant discrepancy even within vehicle classes. For example, among model year 2001 family sedans, the Honda Accord gets 25 mpg city driving and 32 mpg highway driving, with greenhouse gas emissions of 7.0 tons per year. By comparison, the Ford Taurus gets 18 mpg city driving and 27 mpg highway driving with greenhouse gas emissions of 8.9 tons per year.[103]

The *Light-Duty Automotive Technology and Fuel Economy Trends 1975 through 2000* report, published by the U.S. EPA, notes that, despite advances in automotive technologies, fuel economy remains at a 20-year low in the United States due to a sharp increase in less fuel efficient vehicles like minivans, SUVs, vans and pickup trucks.[104] Since 1988 average new light vehicle fuel economy in the United States has declined by 1.9 mpg, or more than 7%.[105] Given that the United States has stricter fuel economy standards than Canada and similar vehicle sales trends, it can safely be assumed that U.S. fuel economy trends apply equally to Canada.

The increasing market share of SUVs and light trucks, which have significantly lower average fuel economy than cars, accounts for much of the decline in fuel economy in the overall new light vehicle fleet. SUV sales in the U.S. have increased by more than a factor of ten, from less

[98] Light vehicles include those vehicles that the U.S. Environmental Protection Agency (EPA) and the U.S. Department of Transportation (DOT) classify as cars or light-duty trucks (sport utility vehicles, vans, and pickup trucks with less than 8,500 pounds gross vehicle weight ratings). Heavenrich, Robert M. and Karl H. Hellman, United States Environmental Protection Agency, Office of Transportation and Air Quality, 2000. *Light-Duty Automotive Technology and Fuel Economy Trends 1975 Through 2000.* Available at: www.epa.gov/otaq/fetrends.htm.

[99] Natural Resources Canada, 2001. *The AutoSmart Website*. Available at: www.autosmart.nrcan.gc.ca/.

[100] The United States Department of Energy and The United States Environmental Protection Agency, 2001. *Fuel Economy Website,* www.fueleconomy.gov.

[101] Greenhouse gas emissions estimates are based on 45% highway driving, 55% city driving, and driving 24,200 km annual (15,000 annual miles). Greenhouse gas emissions are expressed in CO2 equivalents. Estimates are based on the full fuel cycle and exclude vehicle manufacture processes. (U.S. Department of Energy, GREET Model, Argonne National Laboratory). The United States Department of Energy and The United States Environmental Protection Agency, 2001. *Fuel Economy Website.* Available at: www.fueleconomy.gov.

[102] Idem.

[103] Idem.

[104] Heavenrich and Hellman, 2000. See footnote 10.

[105] Idem.

than 190,000 in 1975 (under 2% of the overall new light vehicle market) to over 3.2 million in 2000 (20% of the market). Over the same period, the market share for vans doubled from 4.5% to 9%, and for pickup trucks from 13% to 17%. Between 1975 and 2000, the market share for new passenger cars and wagons decreased from 81% to 54%.[106]

The number of SUVs has doubled in the U.S. since 1992 alone. In 1999, nearly half of the passenger vehicles sold in the U.S. were SUVs or light trucks.[107] In Canada, SUVs and light trucks are forecast to increase in number by 46% between 1997 and 2020 and will likely make up almost 20% of the entire vehicle fleet within 20 years.[108]

From an environmental perspective, this sharp increase in SUV, light truck and minivan sales in the 1990s is clearly of deep concern. SUVs generally get very poor fuel efficiency. The more fossil fuels that are burned, the greater the quantity of greenhouse gases and smog-forming air pollutants that are released, and the greater the long-term costs of non-renewable resource depletion. The Land Rover Range Rover, Lincoln Navigator, GMC Yukon, Dodge Durango, and Ford Expedition all get 12 mpg city driving and 17 mpg or less highway driving and release up to 16.6 tons of greenhouse gas emissions per year.[109]

Fortunately, even within the SUV class, alternatives do exist. For example, the Toyota RAV 4, which is an electric vehicle, gets 117 mpg in city driving and 91 mpg in highway driving, emitting 4.1 tons per year of greenhouse gas emissions (see Table 14).

Table 14. Sport Utility Vehicle Fuel Efficiency and Greenhouse Gas Emissions

Model (2001 year)	City mpg	Highway mpg	GHG emissions
Lincoln Navigator (SUV)	12 mpg	16 mpg	14.3 tons per year
Land Rover Range Rover (SUV)	12 mpg	15 mpg	14.3 tons per year
GMC K1500 Yukon (SUV)	12 mpg	16 mpg	14.0 tons per year
Dodge Durango (SUV)	12 mpg	17 mpg	13.7 tons per year
Ford Expedition (SUV)	12 mpg	17 mpg	16.6 tons per year
Suzuki Vitara 2-door	25 mpg	28 mpg	7.2 tons per year
Toyota RAV 4 (electric)	117 mpg	91 mpg	4.1 tons per year

Source: United States Department of Energy and United States Environmental Protection Agency, 2001. *Fuel Economy Website.*

Every gallon of gasoline that our vehicles burn puts an average of 20 pounds of carbon dioxide into the atmosphere. So even small differences in fuel efficiency can have a significant impact on our personal contribution to global climate change and to our ecological footprint. Choosing a vehicle that gets 25 rather than 20 mpg will prevent 10 tons of carbon dioxide from being

[106] Heavenrich and Hellman, op. cit., Executive Summary, p.3. Available at: www.epa.gov/otaq/fetrends.htm.
[107] USPIRG. 2000. *SUV report*. Available at: www.uspirg.org.
[108] Natural Resources Canada, 1999, see footnote 80.
[109] U.S. Department of Energy, GREET Model, Argonne National Laboratory. United States Department of Energy and the United States Environmental Protection Agency Fuel Economy Website www.fueleconomy.gov.

released over the lifetime of the vehicle.[110] In sum, if we do need to purchase a vehicle, we can reduce our transportation footprint and fuel costs by selecting one that meets our needs with the best fuel economy available. That choice also has the added benefit of substantial savings in fuel costs.

Summary: Reducing Our Transportation Footprint

Personal transportation accounts for almost 20% of the average ecological footprint per person. There are many opportunities to make choices that reduce our impact on the environment: the mode of transportation we choose, what type of vehicle we own, the type of fuel we select, how we drive, and how we maintain our vehicle. The most effective way to reduce our transportation footprint is to drive less, walk and cycle more, use public transportation, and car-pool. Living near our place of work and near amenities such as grocery stores, shopping establishments, schools and recreational facilities can significantly reduce our dependency upon cars.

There is probably no public policy factor that more significantly impacts our capacity to reduce our transportation footprint and our car dependency than how we design our cities. Suburban and ex-urban sprawl necessitates substantially greater travelling distances. Business districts and shopping venues located far from residential areas also encourage car use. Where travelling distance precludes walking or cycling, adequate public transportation facilities are essential to offset the environmental impacts of automobile use. We not only need to choose to drive less, but, as citizens, we must demand that planners, builders and policy makers promote the conditions necessary to ensure sustainable communities. Even the most dedicated personal efforts to reduce our transportation footprint require a conducive and supportive social and public policy environment to create viable alternative transportation options.

14. Household Energy Footprint

We are heavy consumers of household energy

Nova Scotia's current residential energy footprint is 0.99 ha. per person. This is approximately 4% larger than the Canadian average,[111] despite the fact that Canadians on average consume almost 20% more GJ/capita/year than Nova Scotians. Canadians consume 55.69 GJ/capita/year while Nova Scotians consume 46.76 GJ/capita/year.[112]

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110 The United States Department of Energy and The United States Environmental Protection Agency, 2001. *Fuel Economy Website,* www.fueleconomy.gov. See "Why is Fuel Economy Important?"

111 The Nova Scotia residential energy footprint is 0.99 ha. per person. The Canadian residential energy footprint is 0.96 ha. per person. 0.1 ha. per person of the Canadian residential energy footprint is from hydro-electricity and is assessed as built-up land for the purposes of calculating the ecological footprint. This is consistent with the approach used by Mathis Wackernagel in his 1996 Canadian Ecological Footprint. If we looked solely at the land area required for CO_2 absorption, 0.86 ha. per person would be needed to support the average Canadian residential energy footprint. If the built area needed for hydroelectricity were excluded, the Canadian residential energy footprint would therefore be 15% smaller than the Nova Scotian residential energy footprint.

112 This difference may be exaggerated slightly due to the popularity of wood for space heating in Nova Scotia which is difficult to estimate accurately. National Energy Board. 1999. See footnote 58.

Nova Scotia's larger residential energy footprint (despite lower per capita energy consumption) is due primarily to the fact that 89.2% of the electricity derived in Nova Scotia is from coal or oil, while only 32.2% of the electricity in Canada as a whole is derived from coal or oil.[113] Whereas hydroelectricity and natural gas are common sources of energy in the rest of Canada, only 10% of electricity in Nova Scotia is generated through small-scale hydro plants, and conversion to natural gas has not yet occurred (see Table 4, for footprint conversion ratios for different fuel sources). As noted, even without a reduction in household energy use, the impending conversion to natural gas will reduce Nova Scotia's per capita residential energy footprint and bring the province's overall ecological footprint in line with the Canadian average.

The lower average residential energy demand in Nova Scotia in comparison to Canada is due primarily to a more moderate climate and lower heating fuel needs. Despite a more moderate climate, however, Nova Scotia households are prone to a large residential energy footprint in other ways. For example, Nova Scotia has a greater number of older and larger dwellings compared to the Canadian average. A quarter (24.6%) of the dwellings in Nova Scotia were built before 1946 compared to only 15.9% in Canada.[114] Modern homes tend to be significantly more energy efficient, due to improvements in building materials and insulation, and therefore contribute to a smaller energy footprint. Many older homes have little or no insulation, which can increase heating costs by up to 70%.[115]

Dwellings in Nova Scotia are also, on average, slightly larger than in the rest of Canada: 6.4 rooms in comparison to 6.1 rooms, due primarily to a lower level of urbanization.[116] Larger dwellings use more material inputs and have greater space heating requirements, which in turn increases the residential energy footprint. Space heating accounts for 50% of household energy demand in Nova Scotia.[117] In addition, 68% of Nova Scotia's dwellings are single detached houses – over 10% above the Canadian average.[118] Single detached dwellings require more material inputs and energy to heat than apartment dwellings because of the greater number of exterior walls.[119]

15. Reducing Our Household Energy Footprint

Despite Nova Scotia's more rural profile, and the structural contributions to residential energy demand outlined above, there are still a number of practical choices available to households that could significantly reduce the province's residential energy footprint. Indeed, household energy consumption choices are one of the simplest ways that ordinary citizens can reduce their ecological footprint *and* save money. A few intelligent energy choices can reduce our household energy consumption by 50% and save significantly on our household energy costs (Table 15).

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[113] **NS**: 79.5% coal and 9.7% oil; **CAN**: 29% coal and 3.2% oil. About 10% of electricity in Nova Scotia is generated from small-scale hydro plants. National Energy Board. 1999. See footnote 58.

[114] Statistics Canada, 1996. *Nation Series*, *Profile of Census Divisions and Subdivisions in Nova Scotia,* catalogue no. 95-184, *1996* Census.

[115] Residential Energy Efficiency Database, 2000. www.its-canada.com.

[116] Statistics Canada, 1996. See footnote 114.

[117] Nova Scotia Power. 2000. Web site, www.nspower.ca.

[118] Statistics Canada, 1996. See footnote 114.

[119] Walker, Barry. 2000. Personal communication, Energy Advisor Nova Scotia Power.

Table 15. Reducing Household Energy Consumption[120]

Action	Economic Savings	Energy Savings
Switch to a time based-programmable **thermostat** (from a standard non-programmable thermostat)	$288.16*	30%
Turn down the thermostat at night to 17 degrees (based on average household temperature of 21 degrees)	$76.84*	8%
Switch from standard incandescent **bulbs** to a) Halogen bulbs b) Compact fluorescent bulbs (assumes 150 operating hours per month)	 $63.40 $86.45	 55% 75%
Install a low flow **shower head** (assumes a household of four)**	$60.83	50%
Clothes Washer (assumes 34 loads per month) a) Switch to energy efficient model b) Wash clothes in cold water vs. hot water	 $29.94 $107.14	 26% 93%
Clothes dryer (assumes 34 loads per month) a) Switch to energy efficient model b) Hang dry	 $35.70 $115.20	 31% 100%
Dish washer (assumes 34 loads per month) a) Switch to energy efficient model	 $49.56	 40%
Refrigerator (responsible for 15% of household energy use) a) Switch to energy efficient model	 $62.76	 47%-53%
Air Conditioner (assumes 3 month use period) a) Switch to an energy efficient model b) Switch to a fan c) Open windows	 $32.40 $25.92 $64.80	 50% 60% 100%
Add an **insulating blanket** to hot water heater (Assumes an average use of 355 kwh/month = approximate use for household of three)**	$20.40	5%
Clean **furnace filter** regularly	$144.01	15%

* These dollar savings are based on electric heat costs, as detailed on the Nova Scotia Power web site. Actual costs and savings will vary significantly according to household and fuel source. Whatever one's home heating fuel source, however, switching to a time based programmable thermostat or turning down the thermostat at night to 17 degrees will reduce one's household energy footprint and produce comparable overall energy savings. For more information on household heating savings, please visit the Nova Scotia Department of Natural Resources web site, www.gov.ns.ca/natr/energy/homeheat/default.htm.[121]

** Due to different data sources, some proposed actions refer to a household size of three individuals, while others are based on a household size of four.

[120] Annual savings are based on NS Power estimates of typical electrical costs. Calculations assume the current NS Power rate of $0.096 per kilowatt hour. Nova Scotia Power, 2000. Web site, www.nspower.ca.
Actions proposed to reduce residential energy consumption are from the following sources: Alliance to Save Energy, Sponsored by the United States Department of Environment and Environmental Protection Agency, 1998, www.ase.org/powersmart/; Climate Change Calculator, Government of Canada, www.climcalc.net); Global Climate Change, 1999, *Taking Action on Climate Change*; and Residential Energy Efficiency Database, 2000, www.its-canada.com.

[121] Nova Scotia Department of Natural Resources, 2001: www.gov.ns.ca/natr/energy/homeheat/default.htm.

Notes to Table 15:

(1) Percentage energy savings in the third column refer to savings *compared to* conventional non-energy efficient methods and models within each category. For example, switching from a conventional non-efficient dishwasher to an energy efficient dishwasher can save 40% of the energy costs normally associated with washing dishes. In other words, the percentages in column three do not refer to percentage savings of the total energy budget.

(2) NS Power gives the average Nova Scotian's annual electric costs as $1921.09.[122] Annual savings estimates are based on NS Power estimates of typical electrical costs and assume the year 2000 rate of $0.096 per kilowatt hour.

Sources: Nova Scotia Power. 2000. Web site; United States Department of Environment and Environmental Protection Agency Alliance to Save Energy. 1998; Government of Canada, Climate Change Calculator; Global Climate Change. 1999. *Taking Action on Climate Change*; Residential Energy Efficiency Database, 2000.

Smart Energy Decisions

The average Nova Scotian household energy use breakdown is as follows:[123]
Heat: 50%
Hot water: 30%
Appliances: 14%
Lights: 6%

Based on the potential savings outlined in Table 15, it is possible to reduce residential energy consumption from 30-50% and realize savings for each household of up to $1,000 on annual utility bills.

If all Nova Scotians reduced their total residential energy use by 50%, which is the composite saving that can be accomplished by the best practices outlined in Table 15, they would collectively decrease Nova Scotia's annual total residential energy demand by 22 million gigajoules (GJ) or 6.1 billion kilowatt-hours.[124] A 50% reduction in Nova Scotian residential energy demand would avoid more than 1,000 kilotonnes in CO_2 emissions annually, or 5% of total current provincial emissions.[125] Reducing energy demand in this way throughout the country could contribute significantly to Canada's greenhouse gas reduction commitments in accordance with the Kyoto Protocol targets.

Summary: Reducing Our Household Energy Footprint

Table 15 above provides practical suggestions for how we can reduce home energy consumption in various ways without having to make real sacrifices to our lifestyles. Other major savings can be made by:

[122] Nova Scotia Power. 2000. Web site, www.nspower.ca.
[123] Nova Scotia Power. 2000. Web site: www.nspower.ca.
[124] Nova Scotians consume 46.76 GJ/capita/yr (1996), (see footnote 110). The population of Nova Scotia in 2000 was 940,996. Statistics Canada, 2000. Cansim II, Table 051-000, *Estimates of population, by age group and sex, Canada, provinces and territories, annual.* Estimated total Nova Scotia residential energy demand based on 1996 residential consumption trends = 44,000,972.96 GJ/yr. If all Nova Scotians reduced their residential energy demand by 50% = 22,000,486.48 GJ/yr = 6,111.25 GW.h (3,600 GJ = 1 GW.h) = 6,111,246,244 KW.h.
[125] Walker, Sally, 2001 (forthcoming). *The GPI Greenhouse Gas Accounts*.

- turning lights and appliances off when they are not needed;
- limiting the use of air conditioners;
- reducing time spent watching T.V.; and
- having shorter showers.

Perhaps the most effective way to reduce our household energy footprint is simply by raising our level of daily awareness. If we make a conscious effort to evaluate the energy use of our households on an ongoing basis, we will find numerous creative ways to reduce it that match our particular needs and circumstances.

Longer-term changes in technology can also assist efforts to reduce our household energy footprint. Advances in building materials have already significantly decreased the heat loss in homes, and available technologies could reduce this even further.[126]

Reducing household energy consumption on an individual and household level can certainly produce a major reduction in our current household energy footprint. Deeper cuts in energy consumption that will significantly impact our collective future household energy footprint, however, depend primarily on how we design our communities. Will we be living in large single unit dwellings in the suburbs, or more energy-efficient townhouses and apartments in a vibrant community or downtown core?

The planning policies and building codes in effect today will have a significant impact on our future ecological footprint, as they influence both the type of homes and communities in which we will live in the future as well as our transportation needs. It is fair to say that current building codes and planning policies rarely consider energy footprint consequences, and even encourage detached single family home construction that limits personal energy reduction efforts. Higher density housing could encourage development of district heating models that can produce significant energy savings.

When the size of the current Nova Scotia footprint (8.1 ha. per person) is considered against the background of the bioproductive land and sea actually available for human resource use and waste assimilation (1.8 ha. per person), it is clear that dedicated individual efforts alone will not prevent a continued ecological overshoot that imperils the well-being of future generations. A collective political and social will and coordinated public policy planning are essential to reduce our footprint and our impact on the environment significantly, and to take on real responsibility for the well-being of our children and their children.

Fortunately, there are excellent examples and models of community and social efforts to reduce energy consumption and live more efficiently and responsibly. The forthcoming GPI transportation component notes the innovative transportation, planning and design options of Curitiba, Brazil, which has consciously designed itself as an "ecological city."[127]

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[126] Pembina Institute, 2000. Website. Available at www.climatechangesolutions.com.
[127] Cleon Ricardo dos Santos, Open University of the Environment, Curitiba, Brazil, presentation to "Halifax in Motion: Transportation and Land Use," public forum, Halifax City Hall, March 7-8, 2001, sponsored by Department of Urban and Rural Planning, Faculty of Architecture, Dalhousie University.

On the residential energy and planning front, one of the most effective and exciting models is the Danish co-housing experiment, which has been so successful that it has become a mainstream real estate option in that country. Recreating the modern equivalent of a traditional village, 20-25 families typically live in much smaller dwellings but share a "common house" with a wide range of common facilities and appliances, and in which they prepare and eat dinners together. The arrangement facilitates car-pooling, shared child-care, bulk buying and other patterns of community interaction that significantly reduce per capita energy consumption and transportation, while at the same time fostering community.[128]

The Danish co-housing model has spread to the Netherlands, Germany and Sweden, and has now begun to spawn similar experiments in North America.[129] Tax incentives and building codes in Nova Scotia and Canada that promote the type of co-housing development that has proved so successful in Europe would encourage the kind of longer-term structural changes to our housing stock that are necessary to reduce the energy-intensity of current living patterns. The fact that these new housing options can build community and strengthen social supports at the same time that they increase efficiency and reduce energy consumption indicates that there are creative ways of reducing our ecological footprint that enhance our quality of life and well-being.

16. Food Footprint

Nova Scotians are formidable food consumers

The average Nova Scotian food footprint is 2.4 ha. per person, which amounts to 30% of our total ecological footprint. Food consumption is the second largest footprint component after energy. The food footprint is the amount of arable and pastureland required to grow the food and raise the animals that we eat. If we factor in the energy used within the food system, which is estimated to be approximately 13.8% of total energy end use, the total footprint devoted to feeding ourselves averages 2.8 ha. per person, or 35% of our total ecological footprint.[130]

Our current food footprint is clearly unsustainable. A footprint of 2.8 ha. for the average Nova Scotian is 55% larger than the total ecological footprint space available per global citizen, if we assume equal distribution of the Earth's biocapacity. In fact, the Nova Scotia per capita impact from food consumption alone is greater than the average total ecological footprint of 72% of the world's population.[131]

[128] McCamant, Kathryn, and Charles Durrett, 1988, *Cohousing: A Contemporary Approach to Housing Ourselves,* Habitat Press, Berkeley.

[129] Fromm, Dorit, 1991, *Collaborative Communities: Cohousing, Central Living, and other New Forms of Housing with Shared Facilities,* Van Nostrand Reinhold, New York.

[130] Wackernagel, Mathis, 1994. *Ecological Footprint And Appropriated Carrying Capacity: A Tool For Planning Toward Sustainability.* Ph.D thesis, The University of British Columbia. Mathis Wackernagel bases the 13.8% estimate on a number of sources including Canadian agriculture statistics, US Federal Energy Administration and USDA studies, as well as studies done in Switzerland. Estimates from these sources range from 12 to 20%.

[131] Calculated from the *The Living Planet Report 2000* (see footnote 9). An ecological footprint distribution calculator is also available at the Redefining Progress web site www.rprogress.org/java/Footpdist/Footpdist.html.

The ecological space that Nova Scotians occupy just to feed themselves is 2,260,000 hectares, or an area equivalent in size to more than 40% of the total provincial land area.[132] The actual area in food-producing crops and livestock in Nova Scotia is only 139,422 ha., or less than 3% of the provincial land area.[133] From the point of view of the biologically productive land area required to produce food, we actually consume 16 times more than we produce. Nova Scotia is able to adjust for this deficit by importing food through trade. Not only does this make Nova Scotia enormously dependent on the ecological capacity of other regions, but it also contributes significantly to our large food footprint.

17. Why is our Food Footprint so large?

Canadians are overeating

On average, each Canadian eats 3,119 calories worth of food each day (see Table 16).[134] The recommended caloric intake for an active young man (19-24) is only 3,000 calories per day, with average optimal energy requirements just 2,500 for men and 1,900 for women (Table 16).[135] Canadians and Nova Scotians are not only eating more than they need for good health, but they are also eating too much of the wrong kinds of food. The Nova Scotia Nutrition Survey found that 79% of adult Nova Scotians consumed total fat amounts in excess of the recommended level for health.[136]

Aside from increasing the size of our food footprint, overeating and eating too much of the wrong kinds of food are contributing causes to obesity and to a wide range of illnesses. A 1997 survey by the Canadian Medical Association, found that 35% of men and 27% of women are obese and almost 60% of men and 50% of women are at an increased health risk due to excess body fat. Statistics Canada's population health surveys indicate that rates of overweight have more than doubled since 1985 from 13% to 29% in Canada, and from 18% to 38% in Nova Scotia. 40% of Nova Scotian men and 35% of Nova Scotian women have a Body Mass Index of more than 27, defined by Health Canada as conferring a "probable health risk."[137]

According to the Redefining Progress footprint distribution calculator, 72.2% of the world's population has an ecological footprint of 2.8 hectares or less.

[132] 2.4 hectares per person x 940,996 (2000 population estimate for Nova Scotia) = 22,600 hectares. This assumes 2.4 ha. per person which is the amount of arable and pasture land required to grow the food and raise the animals that we eat. It does not include the associated land required for the energy that can be attributed to the food system. The total provincial land area of Nova Scotia is 5,528,400 hectares.

[133] Statistics Canada, 1997. *Agricultural Profile of the Atlantic Provinces,* catalogue no. 95-175. Minister of Industry: Ottawa.

[134] FAO, 1997. Statistical information, www.fao.com.

[135] Nova Scotia Heart Health Program. 1993. *Report of the Nova Scotia Nutrition Survey*.

[136] Idem.

[137] Macdonald, Sharron M.M.D. et al., 1997. "Obesity in Canada a Descriptive Analysis," *Canadian Medical Association Journal*. Vol. 157, No. 1 supplement, S3-S8. In this report "obese" is defined as a BMI equal to or greater than 27 kg/m^2. "Increased health risk due to excess body fat" is defined as a BMI greater than or equal to 25 kg/m^2. Statistics Canada, *Health Indicators,* CD-Rom, 1999, Table 00060211.IVT, gives rates of overweight from 1985 to 1997. It should be noted, however, that Statistics Canada does not use the term "obese," but instead describes those with a BMI of greater than 27 as "overweight." Those with a BMI of 25-27 are described as

Table 16. Caloric Intake World Wide, 1997[138]

	Calories Total	Veg.	Animal	Protein (grams)	Fat (grams)
Canada	3119	73%	27%	97.7	126.3
United States	3699	73%	27%	112.3	142.8
India	2496	93%	7%	59.1	44.5
World	2782	84%	16%	73.9	32.6
Avgerage daily food energy requirements*	Male 2500 Female 1900			70.6 61.3	82.5 62.7

* Estimates are based on average Health and Welfare Canada Nutrition Recommendations (1990). Optimal daily food energy requirements vary according to gender, age category, genetics and level of activity.

Sources: FAO, 1997. *Statistics*; and Health and Welfare Canada, 1990, *Nutrition Recommendations*.

The Canadian Medical Association indicates that obesity reduces quality of life, increases morbidity, and can lead to premature death. Obesity is linked to heart disease, diabetes, hypertension, osteoarthritis, certain types of cancer, and a wide range of other illnesses. A Statistics Canada analysis found that obese Canadians are four times more likely to have diabetes, 3.3 times more likely to have high blood pressure, and 56% more likely to have heart disease than those with healthy weights.[139]

Obese individuals are also nearly twice as likely to die prematurely from all causes than those with healthy weights. Obesity is now recognized by experts as the second-leading preventable cause of death after cigarette smoking. It is estimated that nearly a thousand Nova Scotians die prematurely each year due to obesity-related illness, losing 4,000 potential years of life annually.[140]

Paradoxically, overeating contributes to economic growth many times over, and thereby to our assessment of how "well off" we are. All the excess food grown, processed, transported, warehoused and sold makes the GDP grow. The food industry contributes $33 billion a year in advertising to the U.S. and Canadian economies, more than any other industry, much of it

having "excess weight." For more details on both overweight trends and the costs of obesity to the health care system, see Colman, Ronald, *The Cost of Obesity in Nova Scotia,* GPI Atlantic, Halifax, 2000. Replications of this report for New Brunswick, Quebec, Ontario, Manitoba, Saskatchewan, Alberta and British Columbia are all available in the GPI bookstore at www.gpiatlantic.org.

[138] **Caloric Intake:** FAO, 1997. *Statistics*, www.fao.com. **Average daily food energy requirements:** Health and Welfare Canada, 1990. *Nutrition Recommendations*. Average estimates used. Optimal daily food energy requirements vary according to gender, age category, genetics and level of activity.

[139] Health Canada, 1999, *Statistical Report on the Health of Canadians,* page 264; Health Canada, 1999, *Toward a Healthy Future: Second Report on the Health of Canadians,* page 177; Gilmore, Jason, "Body Mass Index and Health," *Health Reports,* Statistics Canada, catalogue no. 82-003, Vol.11, No. 1, summer 1999; Colman, op. cit., pages 7-8.

[140] *The Halifax Chronicle-Herald,* October 9, 1999, page C1; premature deaths are extrapolated from U.S. figures and adjusted for Nova Scotia obesity rates, based on studies cited in Birmingham, C. Laird, M.D. et al. 1999. "The Cost Of Obesity In Canada," *Canadian Medical Association Journal.* Vol. 160, No. 4, 483-488; Colman, op. cit., pages 7 and 12.

promoting the very foods that cause obesity. Fast food, candy and sweetened cereals account for more than half of food advertising expenditures. The diet and weight loss industries contribute $35 billion more to the U.S. and Canadian economies, and obesity related illnesses $60 billion more. The five-fold increase in diabetes and the burgeoning demand for insulin have become a "growth market" for the pharmaceutical industry.[141]

By contrast, the GPI classifies the costs of overeating and obesity as a cost rather than a gain to the economy, because excess food consumption taxes our natural resource base, our bodies, our health care systems, and our pocketbooks. Lower rates of obesity, a reduction in obesity-related illnesses, and a smaller food footprint are signs of genuine progress in the GPI.

The direct costs of obesity to the Canadian health care system for 10 specific illnesses are estimated at $1.8 billion.[142] When other illnesses such as osteoarthritis are included, and when adjustments are made for demonstrated under-reporting of weight, it is likely that obesity costs the Canadian health care system as much as $3.2 billion. GPI *Atlantic* estimates for Nova Scotia indicate that obesity costs the provincial health care system $120 million annually. When indirect productivity losses due to premature death and disability are added, the total cost of obesity to the Nova Scotia economy is estimated at a quarter of a billion dollars annually.[143]

In sum, if we stop overeating, and eat less foods that are harmful to our health, we can not only reduce our food footprint substantially, but contribute to our health and well-being as individuals and as a society. We can also save millions of dollars annually in taxpayer-funded health care costs. Unlike measures of progress based on the GDP in which "more" is always "better," this is another example where "less" is clearly "better."

Disparities in access to food

Despite the ample food available in Nova Scotia and Canada, there are disparities in access to food and nutritional well-being. The 1999 hunger count survey indicated that over 24,000 Nova Scotians and almost 800,000 Canadians, of whom approximately 42% are children, rely on food banks.[144] Over 120,000 meals a month are distributed in the Halifax regional municipality alone.[145] Although the average Nova Scotian food footprint is large, we do not all contribute to it equally.

The same disparities exist globally. One-fifth of U.S. children are now overweight or obese, a 50% increase since 1980, at the same time that a 1998 U.S. Department of Agriculture Study found that nearly one-fifth of American children are "food insecure," – either hungry, on the edge of hunger, or worried about being hungry. The Worldwatch Institute reports that for the

141 Gardner, Gary and Halweil, Brian, 2000, "Nourishing the Underfed and Overfed, " in *State of the World 2000,* Worldwatch Institute, W. W. Norton and Co., New York; Critser, Greg, "Let Them Eat Fat: The Heavy Truths About American Obesity," *Harper's Magazine,* March 2000; Colman, op. cit.

142 Birmingham et al., 1999. See footnote 138. The total direct costs include expenditures on hospital care, physician services, services by other health professionals, drugs, and other health care and health research.

143 Idem. and Colman, op. cit., pages 14-17.

144 Metro Food Bank. 1999. *Hunger count information and regional statistics*, personal communication.

145 Halifax, Metro Food Bank. 1999. *Hunger count information and regional statistics*, personal communication.

first time in history the number of overweight people in the world now equals the number of underfed people, with 1.1 billion in each group, and with both groups suffering from different forms of "malnutrition." Among U.S. adults, 55% are now classified as overweight, while 56% of children in Bangladesh are underweight.[146]

The global disparities in access to food and nutritional well-being indicate that the responsibility for food footprint reduction rests squarely on the shoulders of the over-consumers . Theoretically, there is sufficient food for all human beings in the world to meet their daily nutritional requirements (see Table 17). However, over 800 million people – or more than 13% of the global population – are chronically undernourished, and are not eating enough to meet minimal energy requirements. In addition, millions more suffer from acute malnutrition during transitory or seasonal food insecurity.[147]

Table 17. Per Capita Global Food Availability[148]

	World	Industrialized Countries	Developing Countries
Total food available*	3939 kcal	6964 kcal	3007 kcal
Optimal energy requirements**	male 2500 kcal female 1900 kcal	male 2500 kcal female 1900 kcal	male 2500 kcal female 1900 kcal

*Food availability figures are total grown in the world, in industrialized countries, and in developing countries, divided by the population of the world, the industrialized countries, and developing countries respectively.

**Optimal energy requirements vary according to gender, age category, genetics and level of activity.

Source: Patriquin, David. 1999. Available at: http://is.dal.ca/~dp/reports/facts.html.

The Canadian agriculture system is energy intensive and becoming more so[*]

Between 1981 and 1996, energy inputs within the Canadian agriculture system increased 7%, and fertilizer inputs grew by 26% (an annual growth rate of 1.4%).[149] These dramatic increases in fertilizer and energy inputs reflect both the increasing mechanization of agriculture and also the fact that more inputs are needed to maintain yields over time as soils become depleted of nutrients. In addition, over this period, pesticide inputs increased by 20%.[150]

146 Gardner, Gary, and Halweil, Brian, 2000. *Underfed and Overfed: The Global Epidemic of Malnutrition,* Worldwatch Paper #150, Worldwatch Institute, Washington D.C.; and Gardner and Halweil, op. cit., *State of the World 2000*, pages 60 and 62.
147 FAO. 1997. Statistical information, www.fao.com.
148 Patriquin, Dave. 1999. Web Site, http://is.dal.ca/~dp/reports/facts.html.
* The author is grateful to Jennifer Scott, GPI Atlantic researcher, for much of the information and the data sources in the food footprint chapters, and in this section in particular, and for her detailed review of early drafts.
149 MacGregor, R.J., in McRae, T., Smith, C., and Gregorich, L (eds.), 2000. *Environmental Sustainability of Canadian Agriculture: Report of the Agri-Environmental Indicator Project*. Agriculture and Agri-Food Canada. Draft report. Chapter 17: "Energy Use Time Series: 1981-1996."
150 Idem.

The average energy input into the Canadian agriculture system between 1992 and 1996 was 18.2 PJ. The energy output was 8.1 PJ – a loss of 55% per unit of input.[151] In 1910, the input/output ratio was 1 to 1.[152] A study of energy inputs and outputs in Danish agriculture found that from 1939 to 1990, the ratio of food produced to fossil energy input declined from 3.9 to 1.0 mainly because of a large increase in the use of fertilizer, fuel, and electricity.[153]

For example, the increasing reliance on synthetic nitrogen fertilizer, made from fossil fuels through an industrial nitrogen fixation process, is one factor in the energy intensity of Canadian agriculture. In addition to the energy intensity and direct greenhouse gas emissions associated with nitrogen fertilizer *use*, the production and transportation of nitrogen fertilizer itself is energy-intensive and contributes to carbon dioxide release. For every kilogram of synthetic nitrogen fertilizer used on farms, one kilogram of carbon (or 3.7 kg of CO_2) is released into the atmosphere.[154]

Organic food production systems that integrate livestock and crop production on the same farm, and which use no synthetic fertilizers and pesticides, are much less energy intensive and dramatically reduce the overall external inputs into agriculture in comparison to conventional food production systems. They come much closer to a balanced energy input versus energy output ratio, while maintaining or increasing the long-term fertility of soils. Organically grown food may also be higher in nutritional value. For example, studies show decreased levels of vitamin C and protein, and increased nitrate levels in chemically fertilized crops when compared to their organic counterparts.[155] Not only do organically grown foods reduce our ecological footprint by requiring less energy inputs, but they may also be healthier, – another example of the potential for ecological footprint reduction to increase rather than compromise well-being.

In Nova Scotia there are 35 organic growers, accounting for only 1% of the agricultural land in Nova Scotia.[156] As in our earlier discussion of more sustainable housing options, public policy can create a more conducive environment for individual food choices that can make it easier for consumers to make ecologically conscious choices. Though it is more environmentally benign and protects natural soil wealth more successfully, organic agriculture is still a marginal activity partly because locally grown organic produce is generally more expensive than conventionally grown imported produce.

Tax incentives structured in proportion to lower energy and chemical inputs would make organic food more affordable, while tax penalties for higher chemical and energy-intensive inputs would

[151] McRae, T. and Smith, C. in .McRae, T., Smith, C., and Gregorich, L (eds), 2000. Op. cit., Chapter 18: "Regional Analysis of Environmental Sustainable Agriculture."
[152] Pembina Institute, 2000. Web site, www.cliamtechangesolutions.com.
[153] Schroll, H. 1994. "Energy-flow and ecological sustainability in Danish agriculture," *Agriculture, Ecosystems and Environment* Vol. 51, 301-310.
[154] Janzen, H., Desjardins, R., Asselin, J., and Grace, B. (eds). 1998. *The Health of Our Air: Toward Sustainable Agriculture in Canada.* Research Branch, Agriculture and Agri-Food Canada Publication 1981/E. Ottawa: Minister of Public Works, p.21. The author is grateful to Jennifer Scott, GPI Atlantic researcher, for much of the information and the data sources in this section.
[155] Nova Scotia Organic Growers Association. 2000. Personal communication with Coordinator Jennifer Melanson, NSOGA@gks.com
[156] Idem. For more information, contact the Nova Scotia Organic Growers Association – (902) 632-2497.

discourage more unsustainable farming methods. In a positive step in this direction, the Nova Scotia Department of Agriculture and Marketing removed the subsidy for synthetic fertilizer purchases.

Much of our food is imported

In Nova Scotia we import an estimated 88% of the food we buy.[157] The average food item travels about 2,000 km to get to the dinner table.[158] Importing such a high percentage of our food has a significant impact on the Nova Scotia food footprint. The transportation costs of shipping food long distances contribute to increased burning of fossil fuels, greenhouse gas emissions, and increased transportation infrastructure costs. On a regional scale, increased reliance on imported food also undermines support of local farmers and rural communities and increases our reliance on other regions of the globe.

If the true costs of transportation and energy (including current taxpayer subsidies), as well as the costs of air pollution, greenhouse gas emissions, and resource depletion were factored into market prices – in other words, if imported food were made to pay its full costs – then a conventionally grown California lettuce would not be cheaper at the supermarket checkout counter than a locally grown organic lettuce. A core purpose of the GPI full cost accounting methods is to factor in social and environmental costs that are currently invisible in conventional market and accounting mechanisms, and thus to make ecological footprint reduction "profitable" rather than costly for the consumer. Sound economic practice and a truly efficient market would support sustainable practices that ensure the maintenance of natural wealth and a reliable flow of goods and services for future generations.

When the grain trade is removed from calculations, Canada is a net importer of agricultural products. Until just after World War II, Canada was self-sufficient in the production of basic fruits (plums, peaches, apricots, strawberries, pears), and vegetables, but by 1980, 28%-57% of these five fruits were being imported.[159] By 1987, Canada was only 71% self-sufficient in the production of fresh vegetables, and 45% in all fruits and berries.[160]

Nova Scotia has experienced a gradual decline in grain self-sufficiency to the point where the shortage of feed grains may imperil the province's ability to raise pork and poultry and may "severely diminish" its capacity to produce beef and dairy products. According to a Nova Scotia Federation of Agriculture discussion paper, PEI is currently self-sufficient in feed grains and has a surplus of barley; New Brunswick is 45% self-sufficient, and Nova Scotia only 15% self-

[157] Scott, Jennifer. 2000. Personal communication with GPI Soils and Agriculture researcher, providing information on sustainable agriculture, based on data from Statistics Canada. 1997. *Agricultural Profile of the Atlantic Provinces.* catalogue no. 95-175. Minister of Industry: Ottawa. For more information on the forthcoming GPI Atlantic *Soils and Agriculture Accounts*, contact GPI Atlantic at info@gpiatlantic.org.

[158] National Round Table on the Environment and the Economy, 1997. *The Road to Sustainable Transportation in Canada,* Renouf Publishing Co., Ottawa.

[159] Toronto Food Policy Council. 1994. *Health, Wealth and the Environment: the impact of the CUSTA, NAFTA and GATT on Canadian food security*, pp. 20-24.

[160] Idem.

sufficient in feed grains.[161] In short, the reliance on imported foods not only increases the province's food footprint by expending additional energy in transportation, but may also undermine the province's long-term food security. Part of Nova Scotia's dependency on food imports is due to the seasonality of the Canadian growing season, but a significant percentage of the crops that comprise this deficit could be produced and stored here if a strong domestic agriculture sector were a policy priority.[162, 163]

The growing dependency on imported food sources in Nova Scotia has been accompanied by a sharp decrease in the total area of provincial farmland. The total provincial area in farms in 1921 was 1,911,553 ha. By 1996 the total area in farms had shrunk to 427,324 ha., just 22% of the amount in 1921 (see Table 18). The population during that period increased by 78%.[164] With farmland decreasing in the province, Nova Scotia has gradually become more dependent on trade to satisfy the food needs of the population.

Table 18. Total Area of Farms in Nova Scotia (1921-1996)[165]

Year	Number of Farms	Area in Farms (ha.)
1996	4,453	427,324
1991	3,980	397,031
1986	4,283	416,507
1981	5,045	466,023
1976	5,434	493,293
1971	6,008	537,777
1966	9,621	749,435
1961	12,518	902,609
1956	21,075	1,123,262
1951	23,515	1,284,347
1941	32,977	1,544,542
1931	39,444	1,740,970
1921	47,432	1,911,553

Source: Statistics Canada, 1997. Historical Overview of Canadian Agriculture.

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161 Woolley, D., 1999. "Feed grains study." *Farm Focus* Vol. 27, No. 7, 14. For a fascinating account of agriculture in Canada from 1886 to 1986 see Anstey, T., 1986. *One Hundred Harvests,* Research Branch Agriculture Canada. Ottawa: Supply and Services.
162 Kneen, B. 1992. "Feeding the family, trading the leftovers." *The Ram's Horn* Vol. 91, 1-4.
163 Warnock, J.W. 1984. Canadian grain and the industrial food system. Presentation to Learned Societies Conference, Guelph, ON. 10 June, 1984.
164 **1921-1970:** Statistics Canada, 2000. Cansim II, Table 051-0024, *Estimates of population, Canada, provinces and territories, annual (Persons)* (series terminated).
1971-1999: Statistics Canada, 2000. Cansim II, Table 051-0001*, Estimates of population, by age group and sex, Canada, provinces and territories, annual.*
165 Statistics Canada, 1997. *Historical Overview of Canadian Agriculture*, catalogue 93-358-XPB, pp.14-15.

Diet changes

Many foods that have a high footprint in energy intensity are also detrimental to health. For example, the report of The Nova Scotia Nutrition Survey revealed that 79% of adult Nova Scotians consumed an amount of total fat in excess of the recommended level for health.[166] In fact, the average adult male total daily fat intake is approximately 15% higher than that recommended.[167] Major food sources of excess fats in the Nova Scotian diet are meats, poultry, eggs, milk, cream and a wide range of processed foods. Although further work is needed on the footprints of particular foods, it is likely that a reduction in fat intake could significantly reduce our food footprint because of the high energy intensity of feedlot grain-fed meat, and of industrial food processing and transportation.

A change in our food consumption towards more grains, vegetables, fruits and natural foods may therefore lead to a healthier diet for Nova Scotians as well as a reduced food footprint. A healthier diet, in turn, can reduce the current high incidence of cardiovascular disease, type 2 diabetes, hypertension, gall bladder disease and cancer, and improve the well-being and quality of life of Nova Scotians. Researchers at the World Cancer Research Fund and the American Institute for Cancer Research report that changes in diet alone could prevent 30%-40% of all cancers world-wide, at least as many cases as could be prevented by a cessation of smoking.[168]

A healthy diet and sustainable agricultural policy that reduce our food footprint do not have to eschew meat products. In an optimal food production system, raising livestock can in fact upgrade human edible energy and protein output. Livestock can consume food grown on lands not suitable for human food and feed not fit for human consumption, such as vegetable culls, grains that do not meet standards, and apple pomace from cider pressings. Optimal food production is an issue of finding the most appropriate use of different types of land and creating a multi-use food landscape. Unfortunately, current production choices are frequently not determined by such careful distinctions based on differential soil quality and land use.[169]

18. Reducing Our Food Footprint

If we understand the causes of our current inordinately high food footprint, we can make intelligent choices that will substantially reduce that footprint and the impact of our current food consumption on the environment. In particular, we can:

1. *Maintain a healthy weight, reduce the tendency to overeat, and not waste food;*
2. *Eat the amount of daily calories that are appropriate for our age and level of activity*

[166] Nova Scotia Heart Health Program. 1993. *Report of the Nova Scotia Nutrition Survey*.
[167] Health and Welfare Canada. 1990. *Nutrition Recommendations: The Report of the Scientific Review Committee*. Ottawa: Minister of Supply and Services Canada. According to the Canadian Nutrition Recommendations, the fat content of the diet should be 33g/1000 kcal.
[168] Birmingham, C. Larid M.D. et al. 1999. See footnote 138; Colman, 2000, op. cit., page 18.
[169] Scott, Jennifer, 2000. Personal communication. See footnote 157.

3. *Eat locally produced foods and support our local farmers, thus reducing high transportation and energy inputs into our food system;*
4. *Eat organically grown and sustainably farmed foods, thus reducing footprint-intensive energy and synthetic, petroleum-based inputs into agriculture;*
5. *Eat more grains, vegetable-based food products and natural foods.*

Public policy that supports local agriculture, organic farming methods, and the best use of land, that mandates high quality nutritional education, and that otherwise helps create a conducive social environment for these consumption choices will produce the greatest and most effective food footprint reductions. As noted in relation to our transportation and residential energy footprints as well, personal choices are limited by incomplete market mechanisms that do not account for social and environmental costs and benefits, and that therefore send misleading price signals to consumers. A core goal of the GPI full-cost accounting mechanisms is simply to make ecological footprint reduction the natural and economically sound path for society and citizens to follow in order to leave a healthy and prosperous inheritance to future generations.

Just one example will suffice here of the substantial potential that exists to reduce the Canadian and Nova Scotian food footprint through public policy measures that encourage sustainable farming practices. It was noted above that the increasing energy intensity of farm inputs, such as synthetic nitrogen fertilizer, is partly responsible for the size of our food footprint. But a 15-year study comparing three maize/soybean systems in the U.S. found that legume-based cropping systems reduced energy use by 50% compared to conventional nitrogen fertilizer-based systems that relied on maize/soybean rotations only.

Legumes reduce carbon and nitrogen losses and increase soil nitrogen storage, thereby reducing the amount of nitrogen that must be applied to maintain yields.[170] While both natural (legume) and industrial nitrogen fixation processes require energy, the first is a virtually "free" service of nature and does not use up non-renewable resources, while the second is expensive and based primarily on the depletion of non-renewable resources.

The study found that application of legume-based cropping practices in the major maize/soybean growing region in the USA would increase soil carbon sequestration by an amount equivalent to 1%-2% of the estimated annual carbon released into the atmosphere from fossil fuel combustion in the USA. This saving is in *addition* to the lower CO_2 emissions from the legume-based farming systems that is due to their 50% reduction in energy use. This shift in agricultural practices would be significant contribution to the U.S.A.'s Kyoto commitment to reduce CO_2 emissions by 7% by 2008-2012.

Best of all, the 15-year U.S. study found no loss in economic viability associated with the shift from conventional synthetic fertilizer-based production using strict maize/soybean rotations to far less energy intensive legume-based cropping methods. Ten-year averages for 1986-1995 maize yields were 7,140, 7,100 and 7,170 kg./ha. respectively for legume systems with manure, legume systems without manure, and conventional systems with fertilizer. In other words, the shift to more sustainable, lower impact and less energy-intensive farming produced no

[170] Drinkwater, L., Wagoner, P., and Sarrantonio, M. 1998. "Legume-based cropping systems have reduced carbon and nitrogen losses," *Nature* Vol. 396, 262-265. The results on this page are all taken from this study.

significant loss in yields. For the past ten years of the experiment, economic profitability from the three systems has been comparable.

The results show the potential for more sustainable farming systems to contribute greatly to a reduction in the size of our ecological footprint. From that perspective, government financial incentives and tax breaks to facilitate the transition to more sustainable farming methods would be an outstanding investment in a sustainable future. This is even truer when other environmental co-benefits are considered. For example, the fixed nitrogen currently used in agricultural activities is responsible for a 60% increase in global levels of biologically active nitrogen 22.

A full cost-benefit analysis that considered such environmental values in addition to reductions in energy intensity would likely judge financial incentives for sustainable agriculture highly cost-effective. Most importantly, for the purposes of this study, the example demonstrates the necessity for joint government-citizen initiatives to reduce our excess ecological footprint. Farmers and ordinary citizens will take the necessary actions to reduce their footprint if there is conducive public policy context to encourage and reward such actions.

19. A Good News Story: Nova Scotia's Solid Waste Footprint

Finally, readers may be wondering whether we, as Nova Scotians, have the individual capacity and collective political will to reduce our ecological footprint substantially. The answer to that question is a simple one, and it is not theoretical. We have *already* demonstrated in practice our ability to act quickly, decisively and effectively to reduce our footprint, and we have created an outstanding model of citizen-government cooperation that has established Nova Scotia as a world leader in solid waste reduction. If we can act effectively in one key area to reduce our impact on the environment without compromising our quality of life, then we most certainly can do so in any of the other areas discussed in this report.

In 1996, the Province of Nova Scotia undertook to manage the solid waste of the province and reduce the pressure on landfills. The Province legislated a goal of 50% diversion of waste from disposal by the year 2000. The steps required to reach this goal are detailed in the Province's Solid Waste Resource Management Strategy[171] and include such programs as curbside recycling, centralized curbside composting, disposal bans, industry stewardship, bottle deposit/refund system, tire return system, and used oil return.

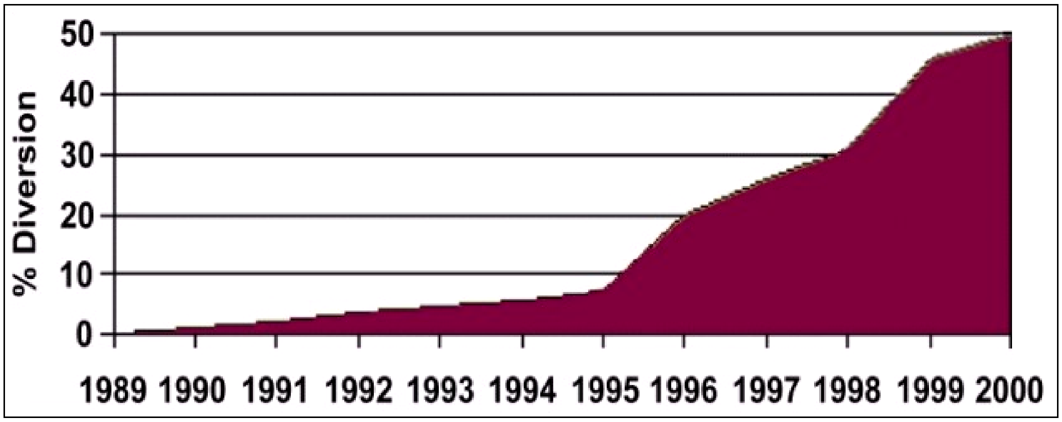
Since 1996, Nova Scotia has become the North American leader in recycling and composting. The 50% diversion goal was accomplished on schedule in 2000 (see Figure 22). This means that 325,314 metric tonnes of waste that would have gone to landfill in 1989, were diverted from landfill in 2000 (see Table 19). The amount of landfill space saved across the province as a result

[171] For an overview of Nova Scotia's Solid Waste Resource Management Strategy, visit the Resource Recovery Fund Board's web site at www.rrfb.com/Glance.html.

of diverting this waste is the equivalent of eliminating six average sized landfills.[172] On a per capita basis, Nova Scotians threw out an average of 712 kg of garbage per year in 1989. At a waste diversion rate of 50%, 356 kg were diverted from landfill for each Nova Scotian in 2000 (see Figure 23).

With government leading and setting specific targets, and citizens willingly cooperating to make the strategy work, Nova Scotians have collectively reduced their solid waste footprint by a full 50% in less than a decade. The strategy has been so successful that Nova Scotia is already regarded as a continental and world leader in the field, and a model that others come to study.

Figure 22. Percentage Waste Diversion in Nova Scotia, 1989-2000[173]



Source: Nova Scotia Department of the Environment, 2001.

Table 19. Per Capita Waste Diversion, Tonnes Diverted, and Percentage Diversion Rate in Nova Scotia's Seven Waste Regions, 1989 (baseline year) and 2000[174]

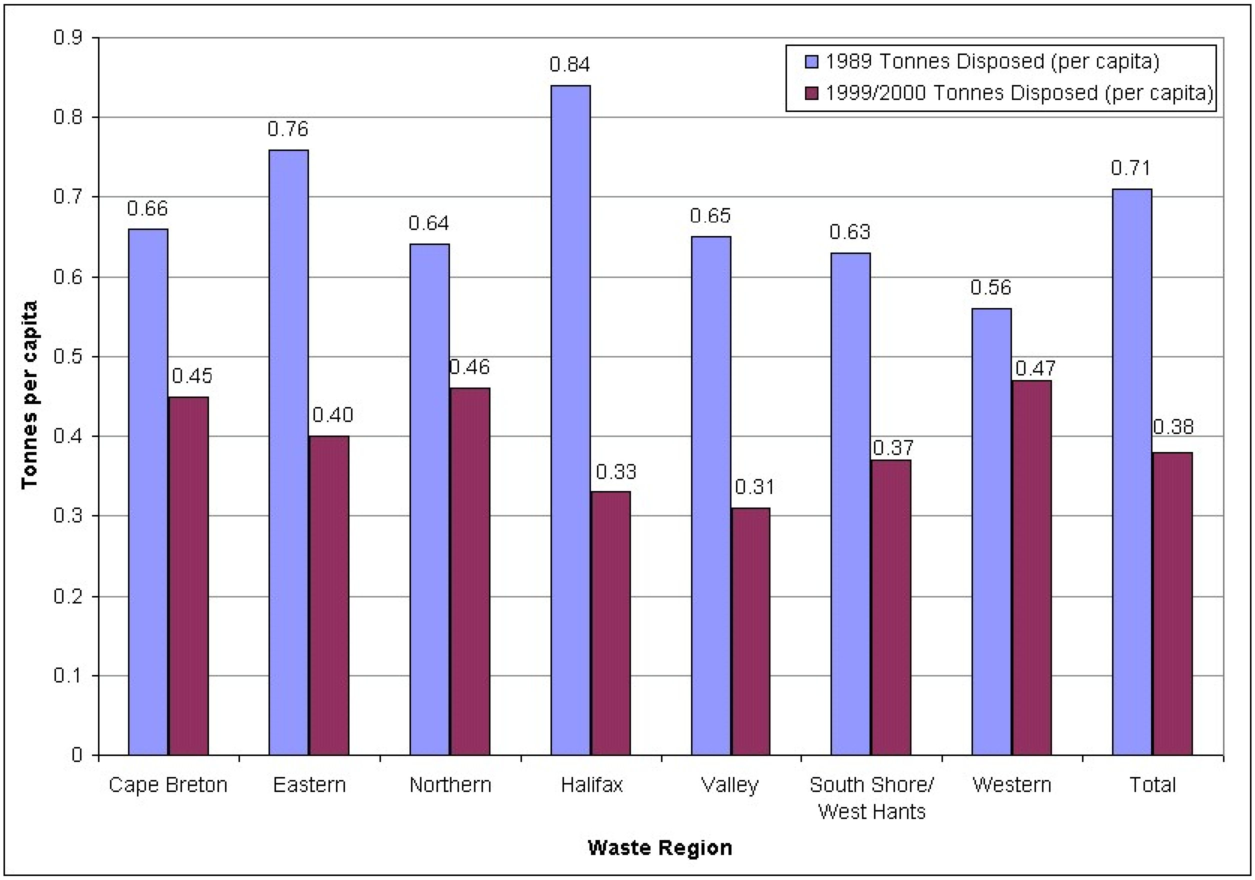
Waste Region	1989 Tonnes Disposed (per capita)	1999/2000 Tonnes Disposed (per capita)	Tonnes Diverted	Diversion Rate (%)
Cape Breton	0.66	0.45	31,833	31
Eastern	0.76	0.40	28,903	48
Northern	0.64	0.46	19,804	29
Halifax	0.84	0.33	186,843	61
Valley	0.65	0.31	29,297	53
South Shore/ West Hants	0.63	0.37	23,232	41
Western	0.56	0.47	5,579	17
Total	0.71	0.38	325,314	47

Note: All values are in metric tonnes. Data were compiled from Regional Solid Waste Management Plans and Semi-Annual Reports from Landfills for the 1999/00 fiscal year.

Source: Nova Scotia Department of the Environment, 2000.

172 Nova Scotia Department of the Environment, 2001. *Recycling and composting facts*. Available at: www.gov.ns.ca/envi/wasteman/r&cfacts.htm.
173 Idem.
174 Nova Scotia Department of the Environment, 2001. *Nova Scotia Solid Waste-Resource Diversion 1999/00 Fiscal Year*. Available at www.gov.ns.ca/envi/wasteman/table.htm.

Figure 23. Per Capita Waste Diversion in Nova Scotia's Seven Waste Regions, 1989 (baseline year) and 2000[175]



Source: Nova Scotia Department of the Environment, 2000.

Some of the other successes of Nova Scotia's Solid Waste Management Strategy since 1996 include:[176]

- 92% of Nova Scotians have access to curbside recycling;
- 70% of Nova Scotians have access to curbside collection and centralized composting of food, waste, leaf and yard waste, and non-marketable paper products;
- Halifax Regional Municipality has diverted over 55% of it's waste stream;
- 600 jobs have been created in the waste management industry;
- A deposit/refund system for beverage containers is in place with an 80% return rate on beverage containers;
- 600 million beverage containers have been recycled since April 1, 1996;
- 2.1 million tires have been recycled since April 1, 1996;
- Over 900 tire retailers have signed stewardship agreements;

[175] Idem.

[176] Resource Recovery Fund Board, 2001. *Nova Scotia's Waste Diversion Accomplishments*. Available at: www.rrfb.com/Accomplishments.html

- Over 200,000 tires have been recovered and recycled from old tire stockpiles;
- Nova Scotia has reduced the land area required for solid waste disposal (its solid waste footprint) from more than 100 dumps and open-burning sites in the 1970's to 19 landfills, with only 9 expected to be operating by 2005; and
- Halifax Regional Munipality is home to two large-scale centralized composting facilities, capable of handling more than 50,000 tonnes of compostable organic material per year.

20. Reducing Our Solid Waste Footprint Further

Towards a Zero Waste Target

Although Nova Scotia has made great and commendable strides in diverting wastes from landfill, there are still many other ways we can continue to reduce our solid waste footprint. In the past, most public policy on solid waste reduction has been narrowly focused on recycling. We have been content with recycling targets ranging from 35-50%. But would we accept 50% unemployment or 50% poverty, or a 50% reduction in famine or disease? We would surely wish to see zero unemployment, zero poverty, zero famine and zero disease. By the same token, we can legitimately set "zero waste" as our ultimate target.

To make further substantial reductions in our solid waste footprint, we need a paradigm shift in how we approach waste issues. Instead of concentrating on managing waste, we should manage *resources* and eliminate *waste*. The concept of "zero waste" unites environmental sustainability, community sustainability and economic sustainability. Zero waste is not only about recycling and diverting waste from landfills and incinerators, but envisions the restructuring of production and distribution systems to prevent waste from being created from the outset.[177]

Practical strategies for a zero waste target include:

- incentives for extended producer responsibility (taking responsibility for the product and its packaging from cradle-to-grave);
- incentives for environmentally friendly product design (products that are produced for durability, easy repair, and/or easy upgrading, including design for the end of the product's life cycle);
- incentives that encourage the use of renewable resources rather than virgin resources;
- resource recovery facilities to enable materials discarded by the community to be reused, recycled, and remanufactured (for example, Nova Scotia's Enviro-Depot system[178]); and
- legislation and economic instruments that encourage conservation and resource recovery, and that penalize unsustainable practices.

[177] Target Zero Canada, 2001. *Beyond Recycling – Zero Waste*. Available at: www.targetzerocanada.org/. See also Hawken, Paul, *The Ecology of Commerce.*

[178] For information on Enviro-Depots in Nova Scotia, visit the Resource Recovery Fund Board's web site at www.rrfb.com/EDlist.html.

However, the real lesson in Nova Scotia's remarkable success in reducing its solid waste footprint by 50% in just a few years, is that the achievement indicates that dramatic and substantial shifts in behaviour and action are actually possible to reduce our ecological footprint. Not only can we reduce our solid waste footprint even further, but we can apply the basic principles and strategy of government-citizen cooperation to footprint reductions in energy use, innovative transportation options, integrated land use/transportation planning, support of sustainable agriculture, and exploration of renewable energy sources like wind power.

In the spirit of past successes, the last chapter proposes a specific footprint reduction target that our solid waste achievements tell us is well within our capacity and reach.

21. Treading Lightly: We Can Reduce our Footprint

The ecological footprint is primarily an educational tool that can help the citizens of Nova Scotia to visualize clearly the impact of their consumption patterns, to become more responsible for their choices, and to move Nova Scotia quickly towards a healthy, sustainable community now and in the future.

The current Nova Scotian ecological footprint of 8.1 hectares per person is clearly not sustainable. Our general lack of awareness of the environmental impact of our resource consumption and waste production has seriously degraded our natural world and undermined our natural wealth. While the complex scientific processes that underlie human interaction with the environment are often difficult for ordinary citizens and policy makers to understand, let alone convert into policy, the ecological footprint is a simple yet powerful means to illustrate and represent the environmental impact of our daily consumption patterns and life choices.

To secure a healthy, vibrant future for our children and grandchildren, and for future generations of Nova Scotians, individuals, businesses, and government can use the ecological footprint concept to accept full responsibility for our current policy and consumption choices and to take the necessary actions to reduce our footprint. The action can begin anywhere, because footprint savings add up quickly.

If all Nova Scotians reduced their individual footprints from 8.1 ha. to 7 ha., which can easily be done through some of the very basic transportation, household energy, and food consumption shifts outlined here, the provincial footprint would shrink by a **million hectares**. That would be a sign of "genuine progress." Rather than measure our progress by economic growth rates as is currently done, **GPI *Atlantic* therefore proposes that a million hectare reduction in the province's ecological footprint be set as an immediate goal, with a 2002 target date**.

Clearly in the long term, the province's ecological footprint needs to be reduced by significantly more than that if we are eventually to live within the actual capacity of the Earth to provide the resources we need and absorb the wastes we produce. Nevertheless, as our solid waste reduction accomplishment has shown, once we face in the right direction, set footprint reduction priorities and clear targets, and begin to act decisively, we can achieve substantial successes in a very short period.

Here are a few basic suggestions to help us get started:

- Walk and ride a bicycle whenever possible.
- Car-pool or take public transportation to work instead of driving alone.
- Keep our vehicles well maintained.
- Buy locally grown and organic foods.
- Consume the number of calories that are appropriate for our age and level of activity.
- Eat more grains and vegetables, and less meat products.
- Reduce, reuse, recycle, and compost.
- Reduce our household energy use by turning off lights and replacing burned out bulbs with halogen or compact fluorescent bulbs; turning down the temperature at night and when not home; hanging out the laundry to dry; insulating walls and roofs; and investing in energy efficient appliances.
- Next time we purchase a vehicle, select a fuel efficient model, and stay away from SUVs, minivans, light trucks and other fuel-inefficient vehicles.
- Next time we move: Live close to work or work in close proximity to where we live.
- Grow a food garden.

Taking such small actions, and others recommended in the preceding pages, will significantly reduce our ecological footprint. If all Nova Scotians took just a few of these simple steps, many of which can improve our health, well-being and quality of life, we can quickly reduce our individual footprints by a hectare per person, and our provincial footprint by a million hectares. Nova Scotia communities can compete with each other in a friendly, constructive way, to determine which one can reduce its footprint most effectively and dramatically, while enhancing the quality of life of its residents. As a province, we can become a model for other Canadians and citizens world-wide, and set new standards of ecologically responsible lifestyles.

Once we get started on this path, we can go deeper. As a society, we can begin to evaluate the underlying nature of our consumer lifestyles in new ways and to ask some tough questions:

- How much of what we consume is a reflection of need? Do we really need that second car or third T.V.?
- How much of our consumption is excessive? How important is a large home?
- How much of our consumption is driven by marketing and advertising?
- How much of our consumption is an attempt to fulfill missing psychological needs?
- Does consuming more really make us happier?
- Might our well-being and quality of life have more to do with strong and caring communities, a healthy environment, and long-term security than with more material consumption?
- How do our consumption habits affect our responsibility to our community, to Nova Scotia, to Canada, and to the world?
- How do we shift our public policy priorities to chart a more sustainable future for our children?

Real footprint savings will come by consuming less, shifting our consumption choices, and changing public policy priorities. As individuals we determine the size of our ecological footprint by our consumption choices. The first choice is to exercise the right not to consume. We also have the power to exercise choice over what products we consume. Purchasing local foods and goods, fuel-efficient car models, and energy-saving household appliances and equipment all offer a smaller footprint than the usual alternatives.

Ultimately, if we are to make the really deep reductions in our huge footprint that are essential to curb our current overshoot and protect our children's future, we will have to act as a society rather than just as individuals. Indeed, our individual actions and commitments will always be constrained by the absence of a supportive social environment, like the lack of alternative transportation options, and by a financial system that constantly sends messages opposed to our intent.

As a society, we have now accepted the need to curb our current fiscal deficit and to reduce the massive public debt accumulated through excessive past spending, and we have finally acted accordingly. The reduction of our ecological deficit, also the product of excessive past spending, will require no less of a public and private mobilization and effort. Fortunately, there are many practical and constructive places to start that can improve our social well-being and strengthen our communities at the same time that they substantially reduce our ecological footprint.

Both in urban and rural areas, how we design our communities has an immense influence on the resource intensity of our lifestyles. There are excellent existing models that can help us develop an infrastructure that:

- reduces our dependency on the automobile,
- ensures safe and easy access to amenities,
- promotes attractive community and town centres and urban villages,
- reduces urban sprawl,
- promotes energy efficient homes and cohousing developments, and
- encourages the use of energy efficient technologies.

How we choose to design our communities today will directly influence the ecological footprint of our children, their quality of life, and the legacy they leave their own children.[179]

This report has also suggested policy actions that can support local agriculture, encourage sustainable farming methods, and promote nutritional education to reduce our food footprint. Investments in public transit, construction of bicycle lanes, incentives for renewable energy development, district heating investments, and a range of other policy initiatives can sharply reduce our energy footprint.

Fortunately we do not have to make anything up. There are excellent models throughout the world of towns, communities, and governments that have successfully taken these and other initiatives, consciously reduced their ecological footprints, and improved the health and well-

[179] Onisto et al., 1998. See footnote 6.

being of their citizens. We can learn from their examples, and borrow the best of what is already available that suits our particular needs and circumstances.

We can *also* learn from what we have already accomplished in the province. Nova Scotians have already dramatically reduced their solid waste footprint and Nova Scotia's world leadership in composting, recycling and solid waste diversion is a model of government-citizen cooperation that can show a sustainable way forward into the future. Bear River's award-winning Solar Aquatic sewage and waste water treatment system has also become a model of sustainable water use.[180] Clearly, footprint reductions are not only possible but have already been successfully accomplished in some areas.

In the early 1980s too, Nova Scotians substantially reduced their energy footprint through switching to smaller, fuel-efficient cars, insulating their homes and other conservation measures, though the provincial energy footprint has started to creep upwards again in the 1990s. Today our total energy footprint (4.5 ha./person) is still 25% smaller than it was in 1979, but it is also 40% larger than it was in 1961. Nova Scotia today is at a crucial point in its history in developing an energy policy for the future. The innovative work of the Western Valley Development Authority in exploring wind-powered electricity generation in the Annapolis Valley could produce a model for the future that would substantially reduce the province's energy footprint [181]

The average Nova Scotian's total ecological footprint (8.1 ha./person) is just two-thirds the size of the average American's footprint (12.2 ha./person), but it is still 30% higher than the average West European's footprint (6.3 ha./person), indicating that we might more productively look to Europe and elsewhere for workable models of sustainable development rather than to the United States. Denmark, for example, has become a world leader in wind energy; the Netherlands is actively promoting organic farming and bicycle use; BMW cars are now made with 35% recycled parts[182]; and Curitiba, Brazil, has become a world leader in integrated land use / transportation planning and mass transit use.

In sum, for a Nova Scotia determined to reduce its ecological footprint, there is no shortage of outstanding examples of sustainable living and development, including powerful ones within its own borders. The effort to reduce our ecological footprint will require government, business and citizen participation. Policy makers and businesses can play a key leadership role in encouraging, supporting and investing in sustainable initiatives. To forge a viable future for our children, Nova Scotians will have to work together to bring about the changes necessary to make Nova Scotia a healthy, vibrant and sustainable province that we are proud to leave as an inheritance to future generations and that can serve as a model for others.

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[180] Gulf of Maine Council on the Marine Environment, 1997. Gulf of Maine Times. Available at: www.gulfofmaine.org/times/spring97/page5a.html.
[181] "Harnessing the Wind," *The Chronicle-Herald,* Halifax, 22 February, 2001, page B1
[182] "MP Looks for Better Method to Measure Canada's Success," *The Kingston Whig-Standard,* 21 February, 2001.

APPENDIX A
THE NOVA SCOTIA GENUINE PROGRESS INDEX: PURPOSES, PRINCIPLES AND METHODS

Limitations of the GDP as a Measure of Progress

The most commonly used basis for assessing economic and social well-being is the Gross Domestic Product (GDP). Yet, in recent years there has been increasingly widespread acknowledgement by leading economists of the shortcomings of the GDP as a comprehensive measure of progress. Indeed, as an aggregation of the market value of all goods and services, the GDP was not intended, even by its architects, as a composite index of economic welfare and prosperity.

Using GDP levels and economic growth rates to measure progress takes no account of the value of natural, human and social capital, including environmental assets, unpaid work, and free time. It does not allow policy makers to distinguish the costs and benefits of different economic activities, and it masks changes in income distribution. Such fundamental omissions and limitations render the GDP an inadequate measure of social and economic well-being.

It should be noted that these are not flaws of the GDP per se, but of its misuse as a benchmark of economic and social health, prosperity and welfare. Nobel Prize winner, Simon Kuznets, one of the principle architects of national income accounting and the Gross National Product, never endorsed its modern use as an overall measure of progress. As early as 1934, Kuznets warned the U.S. Congress:

> *The welfare of a nation can scarcely be inferred from a measurement of national income* (Cobb et al., 1995).[183]

As the GNP and its successor, the GDP, began increasingly to be used as a measure of general social well-being and progress after the Second World War, Kuznets' reservations about the limitations of the system he helped create grew stronger and he argued that the whole system of national accounting needed to be fundamentally rethought. In 1962 he wrote:

> *Distinctions must be kept in mind between quantity and quality of growth, between its costs and return and between the short and the long run. Goals for 'more' growth should specify more growth of what and for what*.[184]

When the GDP is misused as a measure of well-being and progress, it frequently sends misleading and inaccurate signals to policy makers that in turn results in the depletion of vital resources and investment in economic activities that carry hidden social and environmental costs. What we count and measure is a sign of what we value. By focusing on quantitative material

[183] Cobb, C., Halstead, T., and Rowe, J., 1995, *The Genuine Progress Indicator: Summary of Data and Methodology,* Redefining Progress, San Francisco, California.
[184] Kuznets, Simon, *The New Republic,* Oct. 20, 1962, (cited in Cobb *e*t al.. 1995).

growth as our primary measure of progress, we under-value the human, community and social values and environmental quality which are the true basis of long-term well-being, prosperity and wealth.

The flaws inherent in the misuse of the GDP as a measure of progress include the following:

The Failure to Value Natural Capital

The GDP is a current income approach that fails to value natural and human resources as capital assets subject to depletion and depreciation. As such it cannot send early warning signals to policy makers indicating the need for re-investment in natural and human capital. For example, the GDPs of Newfoundland and Nova Scotia registered massive fish exports as economic growth, but the depletion of fish stocks appeared nowhere in the accounts. Similarly, the more trees we cut down and the more quickly we cut them down, the faster the economy will grow. Measured from the consumption side, the more voraciously we consume energy, fish, timber and other resource products, the "better off" we are assumed to be.

The Failure to Make Qualitative Distinctions

Secondly, the GDP itself is a quantitative measure only and fails to account for qualitative changes, both in the mix of economic activity and in the quality of our goods and services including ecosystem services.[185] This failure can send perverse messages to policy makers, with pollution actually registering as a contribution to economic prosperity. The *Exxon Valdez*, for example, contributed far more to the Alaska GDP by spilling its oil than if it had delivered its oil safely to port, because all the clean-up costs, media activity, legal expenses and salvage operations made a huge contribution to the state's economic growth statistics.

Thus, water pollution and bottled water sales are literally "better for the economy," according to our economic growth statistics, than free, clean water, simply because more money is spent on the former. Repairing the damage from extreme weather events and natural disasters due to climate change is actually counted as a contribution to our prosperity and well-being when the GDP is used to assess how "well off" we are. This happens because the GDP blindly records all money spent as a contribution to the economy, without assessing whether this spending actually signifies an improvement in well-being or a decline.

This incongruity extends even to ordinary household purchases. There is no recorded relationship, for example, between the cost of consumer durables as capital investments on the one hand and the quality of services they provide on the other, leading to the paradox that the quicker things wear out and have to be replaced, the better for the GDP.

In sum, this failure to account for qualitative changes means that increases in crime, divorce, gambling, road accidents, natural disasters, disease, obesity, mental illness and toxic pollution all

[185] The Canadian System of National Accounts (CSNA) as a whole does provide information on shifts in the mix of economic activity by sector, industry, commodity and province. These remarks, therefore, apply only to the use of GDP as a measure of progress, since industry and commodity shifts registered in the CSNA are rarely invoked as signals of changes in societal well-being and prosperity.

make the GDP grow, simply because they produce additional economic activity. More prisons, security guards, burglar alarms, casinos, accident costs, storms, natural disasters, dieting pills, anti-depressants, lawyers, oil spill and pollution clean-ups and the costs of setting up new households after family breakups, all add to the GDP and are thus conventionally counted as "progress."

This anomaly led Robert Kennedy to remark 30 years ago:

> *Too much and too long, we have surrendered community excellence and community values in the mere accumulation of material things... The (GDP) counts air pollution and cigarette advertising and ambulances to clear our highways of carnage. Yet the gross national product does not allow for the health of our children, the quality of their education, or the joy of their play. It measures neither our wit nor our courage; neither our wisdom nor our learning; neither our compassion nor our devotion to our country. It measures everything, in short, except that which makes life worthwhile.*[186]

In short, because GDP statistics make no qualitative distinctions, they do not reveal whether expenditures signify an improvement in well-being or a decline. Standard economic growth measures are simply incapable of sending any meaningful signal about natural resource health, and of distinguishing gains from losses. Indeed, resource yield statistics, though conventionally used to signal industry health, may well signify the precise opposite from the perspective of long-term sustainability.

Other Limitations

Thirdly, because it excludes most non-monetary production, the GDP records shifts in productive activity from the household and non-market sectors to the market economy as economic growth, even though total production may remain unchanged. Thus, paid child care, hired domestic help and restaurant food preparation all add to the GDP, while the economic values of parenting, unpaid housework, home food preparation and all forms of volunteer work remain invisible in the economic accounts.

Fourthly, market productivity gains may result in greater output *or* increased leisure, but the GDP counts only the former. Longer paid working hours add to GDP growth by increasing output and spending, but free time is not valued in our measures of progress, so its loss counts nowhere in our accounting system. Given this imbalance, it is not surprising that the substantial economic productivity gains of the last 50 years have manifested in increased output, incomes and spending, while there has been no real increase in leisure time.

Omitting the value of unpaid work and free time from our measures of progress has important implications for the changing role of women in the economy, who have entered the paid workforce in growing numbers without a corresponding decline in their share of unpaid work. Indeed, as the "value of leisure time" module in the GPI demonstrates, women have experienced an increase in their total work-load and an absolute loss of leisure time.

[186] Kennedy, R., 1993. "Recapturing America's Moral Vision," in *RFK: Collected Speeches*, Viking, New York.

The failure to value leisure time is directly related to natural resource and environmental health and well-being. Blind economic growth and material gain have been the major anthropogenic forces fuelling ecological degradation, including the depletion and deterioration of vital natural resources and the dangerous warming of the planet. Re-examining work patterns in industrialized nations to value increased leisure rather than income growth alone as a key to well-being, can make a vital contribution to ecological health and stability.[187]

Finally, because it does not account for income distribution, GDP growth may mask growing inequality. GDP may rise substantially, as it has in recent years, even while many people are getting poorer and experiencing an actual decline in real wages and disposable income. The benefits of what experts refer to as "strong" and " robust" economic growth, based on GDP measurements, may be distributed very unequally. The trend towards rising inequality in a period of strong economic growth has been even more pronounced in the United States than in Canada.[188]

These shortcomings and others led to a recent joint declaration by 400 leading economists, including Nobel Laureates:

> *Since the GDP measures only the quantity of market activity without accounting for the social and ecological costs involved, it is both inadequate and misleading as a measure of true prosperity... New indicators of progress are urgently needed to guide our society... The Genuine Progress Index (GPI) is an important step in this direction*.[189]

The Development of Expanded Accounts

Fortunately, considerable progress has been made in the last 20 years by the World Bank, OECD, United Nations, World Resources Institute and other international organizations, by national statistical agencies, including Statistics Canada and by leading research institutes and distinguished economists, in developing expanded economic accounts which include critical social and environmental variables. The new internationally accepted guidelines in *The System of*

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[187] For an outstanding exposition of this relationship, see Anders Hayden, *Sharing the Work, Sparing the Planet: Work Time, Consumption and Ecology,* Between the Lines, Toronto, 1999.

[188] Cobb, C., Halstead, T., and Rowe, J., 1995, *The Genuine Progress Indicator: Summary of Data and Methodology,* Redefining Progress, San Francisco, California; Messinger, Hans, 1997, *Measuring Sustainable Economic Welfare: Looking Beyond GDP,* Statistics Canada, unpublished manuscript, Ottawa. Messinger demonstrates that the absolute decline in the original U.S. Genuine Progress Index since the early 1970s is largely due to growing disparities in income distribution in that country. Rising inequality is registered in column B of the original GPI as an adjustment to personal consumption based on the share of national income received by the poorest 20 percent of households.

[189] Signatories include Robert Dorfman, Professor Emeritus, Harvard University; Robert Heilbroner, Professor Emeritus, New School for Social Research; Herbert Simon, Nobel Laureate, 1978; Partha Dasgupta, Oxford University; Robert Eisner, former president, American Economics Association; Mohan Munasinghe, Chief, Environmental Policy and Research Division, World Bank; Stephen Marglin and Juliet Schor, Harvard University; Don Paarlberg, Professor Emeritus, Purdue University; Emile Van Lennep, former Secretary General, OECD; Maurice Strong, Chair, Ontario Hydro and Secretary General, Rio Earth Summit; and Daniel Goeudevert, former Chairman and President, Volkswagen AG. Full text and signatory list available from *Redefining Progress*, One Kearny St., San Francisco, CA 94108.

National Accounts 1993 suggest that natural resources be incorporated into national balance sheet accounts and that governments develop a "satellite system for integrated environmental and economic accounting," and a satellite account to measure the value of unpaid household work.

Accordingly, Statistics Canada, in December, 1997, released its new *Canadian System of Environmental and Resource Accounts (CSERA),* which consist of natural resource accounts linked to the national balance sheets, material and energy flow accounts linked to the input-output tables and environmental protection expenditure accounts. Statistics Canada has sponsored an international conference on the measurement of unpaid work, has produced its own extensive valuations of household work and is developing a *Total Work Accounts System (TWAS)* which includes both paid and unpaid work (Statistics Canada 1997; Stone and Chicha 1996). Every six years an extensive time use survey is now part of Statistics Canada's General Social Survey. Other agencies are also moving in this direction. Human Resources Development Canada, for example, has recently issued an Index of Social Health for all the provinces and for the country as a whole.

Some composite indices, like the Measure of Economic Welfare (MEW), the Index of Sustainable Economic Welfare (ISEW), the Genuine Progress Indicator (GPI) and the Index of Economic Well-being (IEW), incorporate up to 26 social and environmental indicators, including unpaid work, income distribution, changes in free time and valuations of natural capital and the durability of consumer goods.[190] These indices also distinguish direct contributions to economic welfare from defensive and intermediate expenditures and from economic activities that produce an actual decline in well-being. There have been continuing improvements in methodologies and data sources in recent years and excellent models are now available for application.

In fact, the current interest in social indicators and comprehensive measures of progress owes a strong debt to the pioneers in this field of the late 1960s and early 1970s, who recognized the limitations of the GDP and sought to go beyond them. Nordhaus and Tobin's Measure of Economic Welfare and similar efforts to expand the definition of national wealth led to the development of new measurement instruments which today form the basis of recent efforts in this field.

At that time, in the early 1970s, the pioneers' understanding of the potential importance of time use surveys and environmental quality indicators was not matched by the availability of data in these fields. The early recognition of the importance of valuing natural resources, for example, initiated the process of gathering data that did not exist at the time. The work of Andrew Harvey and others in constructing the first standard time use surveys, the development of state of the environment reporting in the same era and the emergence of other important social indicator measurement tools, have now produced and made available the actual databases that make the Genuine Progress Index possible.

[190] Cobb et al., op. cit., Messinger, op. cit., Osberg, Lars, and Sharpe Andrew, 1998, *An Index of Economic Well-being for Canada,* presented at the Conference on the State of Living Standards and the Quality of Life in Canada, Centre for the Study of Living Standards, Ottawa. Messinger compares the MEW and the original GPI and replicates the models for Canada. On the original Genuine Progress Indicator, see Cobb et al., op. cit. See also GPI Atlantic, 1998, *Measuring Sustainable Development: Application of the Genuine Progress Index to Nova Scotia,* and GPI Atlantic, 2000, *Project Profile*. Available at: www.gpiatlantic.org.

For the first time, 10 and 20-year time series for social and environmental indicators can actually be created. In short, the construction of an actual policy-relevant GPI at this time should not be seen as a "new" phenomenon, but as a natural evolution of earlier work in the field. The basic principle linking and integrating the components of these expanded accounts is the view of "sustainable development," which reflects a concern (a) to live within the limits of the world's and the community's resources and (b) to ensure the long-term prosperity and well-being of future generations.

Both inter-generational and intra-generational equity are cited as specific characteristics of sustainability in the Brundtland Commission's seminal definition of sustainable development:

> *Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs... But physical sustainability cannot be secured unless development policies pay attention to such considerations as changes in access to resources and in the distribution of costs and benefits. Even the narrow notion of physical sustainability implies a concern for social equity between generations, a concern that must logically be extended to equity within each generation.*[191]

Statistics Canada notes that, from this definition,

> *A consensus has emerged that sustainable development refers at once to economic, social and environmental needs… A clear social objective that falls out of the definition (of sustainable development) is that of equity, both among members of the present generation and between the present and future generations... It is clear that the spirit of sustainable development implies that all people have the right to a healthy, productive environment and the economic and social benefits that come with it.*[192]

The new accounts also use cost-benefit analysis that includes environmental and social benefits and costs and an investment-oriented balance sheet approach that includes natural and social capital assets, to provide a more comprehensive view of progress than is possible with the current-income approach of the GDP.

The current emphasis on "growth" is replaced, in the new accounting systems, by a concern with "development," as defined by former World Bank economist, Herman Daly:

> *Growth refers to the quantitative increase in the scale of the physical dimension of the economy, the rate of flow of matter and energy through the economy and the stock of human bodies and artifacts, while development refers to the qualitative improvement in the structure, design and composition of physical stocks and flows, that result from greater knowledge, both of technique and of purpose.*[193]

[191] World Commission on Environment and Development (Brundtland Commission), 1987. See footnote 2.

[192] Statistics Canada, 1997, *Econnections: Linking the Environment and the Economy: Concepts, Sources and Methods of the Canadian System of Environmental and Resource Accounts,* catalogue no. 16-505-GPE, Ottawa.

[193] Daly, H., 1994, "Operationalizing Sustainable Development by Investing in Natural Capital," in Jansson, A., Hammer, M, Folke C., and Costanza, R. (editors), *Investing in Natural Capital: The Ecological Economics Approach to Sustainability,* International Society for Ecological Economics, Island Press, Washington, D.C.

Values, Approach, Methods and Data Sources in the Nova Scotia GPI

In essence, the fundamental approach of the Nova Scotia Genuine Progress Index is to assess the economic value of our social and environmental assets and to calculate their depreciation or depletion as costs. Maintenance of these capital assets is seen as providing the basis for economic prosperity. As such, the Nova Scotia GPI is a step towards fuller cost accounting than is possible by valuations of produced capital alone.

Value-Based Measures

Any index is ultimately normative, since it measures progress towards defined social goals. All asset values can therefore be seen as measurable or quantifiable proxies for underlying non-market social values such as security, health, equity and environmental quality.[194] In the case of this particular component of the GPI, the normative value or goal that serves as the standard for measuring genuine progress is a reduction in human impact on the environment.

Despite the inclusiveness of the GPI approach, there is no question that it does represent a fundamental challenge to current assumptions and practices. When the GDP and economic growth statistics are used to assess well-being and prosperity, more production, more spending, and more consumption are signs of progress. In short, "more" is always "better." In the GPI, by contrast, "less" is frequently "better." *Less* crime, pollution, sickness, accidents, natural resource depletion and fossil fuel combustion (the primary source of greenhouse gas emissions) are indicators of genuine progress from the GPI perspective, in marked contrast to the GDP, which counts increases in all these areas as contributions to prosperity.

Although the materialist illusion that "more" is always "better" is still pervasive, the GPI approach is actually common-sense economics that reflects universally shared social values. The GPI quite simply counts crime, pollution, sickness, natural resource depletion and greenhouse gas emissions as *costs* rather than gains to the economy, with reductions signifying "savings" to society and improvements in long-term well-being.

It must be emphasized here that there is no escape from the normative basis of any measure of progress. When the GDP is used to assess well-being, it is not objective (as is generally assumed), but embodies the value that "*more*" production and "*more*" spending are always *"better."* The GPI accounting system also has an explicit value base. In this case, the normative values are that less crime, less pollution, a stable climate, and a healthy environment are "better" for human well-being than more crime, more pollution, climate instability, and a degraded environment.

GPI Atlantic feels confident, as a result of 18 months of extensive consultations, that its core GPI indicators represent consensus values among Canadians beyond any partisan or ideological viewpoint and are not counter-intuitive to basic common sense. It is the unexamined assumption that the GDP and economic growth measures are "neutral" and "objective" measures of well-

[194] For the Nova Scotia GPI, these norms are defined in *Measuring Sustainable Development: What the Genuine Progress Index Can Do For Nova Scotia,* pages 12-15: presentation to the N.S. Government Inter-Departmental Consultation, March 3, 1998, World Trade and Convention Centre, Halifax. Available at: www.gpiatlantic.org.

being, that allows their misuse for a purpose that the architects of national income accounting never intended. Once examined closely, that false assumption quickly falls apart and the GPI values are seen as representing the common goals and shared objectives of Canadians.

One important caveat must be added here for the natural resource and environmental components of the GPI. Unlike some of the GPI social and economic components like crime and employment where impacts are more immediately felt, the impacts and costs of natural resource depletion and degradation can be subtle and long-term. This lack of immediacy frequently blunts policy initiatives designed to support more sustainable economic practices. The inclusion of environmental and resource accounts in the Genuine Progress Index therefore requires that we transcend a narrow short-term perspective and comprehend our "well-being" in terms of impacts on our children, on future generations and on other species.

The challenge to conventional thinking is particularly acute because our own prosperity may temporarily increase by expanding our consumption of the world's resources, just as our standard of living appeared to rise in the 1980s through an expansion of government spending and debt. Again, it takes some raising of awareness to understand that the costs and impacts of excessive current consumption will be borne by our children and by future generations, whether through debt-induced service reductions, climate change damage cost or depleted natural resources.

Because the connection between natural resource health and well-being therefore clearly requires a longer-term perspective than some other components of the GPI, and because the immediacy of our narrower conventional desires frequently inhibits that perspective and undermines effective policy initiatives, a key purpose of this report is simply to raise awareness among ordinary Nova Scotians.

If this province is to take a lead in acting responsibly to protect the world's resources and environment and the interests of future generations, a concerted educational campaign will be necessary for Nova Scotians to support actions which can become a model for the country and the world. This report is intended primarily as a contribution to that educational effort.

Data Sources and Methodology

The Nova Scotia GPI uses existing data sources in its valuations and applies the most practical and policy-relevant methodologies already developed by the World Resources Institute, the OECD, the World Bank, national statistical agencies and other established research bodies. In particular, the Nova Scotia GPI relies on published data from Statistics Canada, Environment Canada, the NS Department of Natural Resources (DNR), Department of Fisheries and Oceans (DFO) and other government sources where ever possible, to ensure accessibility and ease of replication by other jurisdictions.

Inevitably, the assessment of the environmental impacts of human economic and social activity is an imprecise science, and predicted long-term changes due to current consumption patterns are uncertain. When future impacts are uncertain but *potentially* damaging and even irreversible, the Genuine Progress Index follows the "precautionary principle." This widely accepted dictum, enshrined in the Nova Scotia Environment Act and in Canada's international commitments, holds that scientific uncertainty must not be a cause for inaction when there is the potential for serious environmental damage.

Further work is clearly needed to improve this ecological footprint analysis. In particular, GPI Atlantic has recommended to Statistics Canada that the input-output tables be used to assess ecological footprints more accurately, and has offered to work with Statistics Canada in that endeavour. A ground-breaking New Zealand ecological footprint analysis using that country's input-output tables creates a first-rate model for a completely different (and far more precise) methodology for footprint analysis in Canada. Nevertheless, GPI Atlantic is convinced that the conclusions in this report contain sufficient evidence of ecological "overshoot" to warrant significant changes in current consumption practices at this time. If more conclusive evidence to the contrary, based on improved methodologies and data sources, becomes available over time, then policy can shift accordingly.

The fundamental approach used in all GPI natural resource accounts is to value resources as natural capital assets that perform a wide range of interconnected ecological, social and economic functions and provide both direct and indirect services to human society and the economy. These assets are also subject to depreciation, just as manufactured capital is, with two important caveats. First, unlike manufactured capital, the services provided by renewable natural capital can be sustained over time, and there is therefore no *inherent* reason for forests, soils, fisheries and water resources to depreciate if they are used responsibly. Secondly, again unlike manufactured capital, lost ecosystem services are frequently irreplaceable, as for example when species become extinct. Nevertheless, it is completely appropriate to consider resource depletion and degradation as a depreciation of value from an economic point of view.

In its methodologies and approach, the Nova Scotia GPI is designed as a pilot project for Canada and to that end has received invaluable assistance from Statistics Canada in data access, consultation on methodologies and analysis, advice and review of draft reports, and staff support. Start-up funding for the Nova Scotia GPI was provided by the Nova Scotia Department of Economic Development and ACOA, through the Canada – Nova Scotia Cooperation Agreement on Economic Diversification. For more information on the background, purposes, indicators, policy applications and methodologies of the Nova Scotia GPI as a whole, please see the background documents on the GPI Atlantic web site at www.gpiatlantic.org

A primary goal of the Nova Scotia GPI is to provide a data bank that can contribute to the Nova Scotia government's existing outcome measures. The reports and data will therefore be presented to Nova Scotia policy makers stressing the areas of policy relevance. Conclusions will emphasize the most important data requirements needed to update and maintain the index over time. The GPI full-cost accounting methods, that include social and environmental values, can also be used to evaluate the impacts of alternative policy scenarios and particular investment strategies on overall progress towards sustainable development in the province.

What the GPI is Not

Just as the GDP has been misused as a measure of progress, there are also several potential misinterpretations of the GPI and misuses of the data it presents. These will be discussed in detail within each of the separate modules as they are presented. But it may be helpful to list some of the major issues at the start.

First, the GPI is not intended to replace the GDP. The GDP will undoubtedly continue to function for the purpose for which it was intended, as a gross aggregate of final market production. It is not, therefore, that the GDP itself is flawed. It is the *use* of the GDP as a comprehensive measure of overall progress that is being challenged and it is this need that the GPI attempts to address.

Identifying omissions from our measures of progress does not imply that the GDP itself should be changed to include these assets. The purpose of the GPI reports, therefore, is not to suggest that unpaid work and non-market forest values should be included in the GDP, or that the costs of crime, water pollution and climate change damage be subtracted from the GDP. Nor do the GPI natural resource accounts and environmental quality valuations recommend the creation of a "green GDP," or "net domestic product" which subtracts defensive expenditures on environmental protection. This can be done, but it is not the purpose of the GPI.

Rather than suggesting changes to the GDP, the GPI in effect adopts a qualitatively different approach. While the GDP is a current income statement, the GPI presents a balance sheet of social, economic and environmental assets and liabilities and reports the long-term flows or trends that cause our assets to appreciate or decline in value. It is only our current obsession with short-term GDP growth trends that is misplaced. The GPI seeks to "put the GDP in its place" rather than to abolish or change it. If the GDP is simply used for the purposes its architects intended, then there is no problem with the GDP per se.

The authors of the original U.S. GPI suggested that misuse of the GDP is analogous to evaluating a policeman's performance by adding up the total quantity of street activity he observes, with no distinction between dog walkers, car thefts, children playing, and assaults (Cobb et. al. 1995a). Just as we expect more of our policeman -- the capacity to distinguish benefit from harm, for example, so we need a performance measurement capable of distinguishing the benefits and costs of economic activity. To extend the metaphor, the GDP is still necessary, just as the quantity of street activity is still important in order to decide where to deploy the policeman most effectively. But once deployed, effective policing and effective policy can only be judged by qualitative criteria.

Second, the GPI assesses the economic value of social and environmental assets by imputing market values to the services provided by our stock of human, social and environmental capital. But this imputation of market values is not an end in itself. It is a temporary measure, necessary only as long as financial structures, such as prices, taxes and monetary incentives, continue to provide the primary cues for the actual behaviour of businesses, consumers and governments.

Monetization is only a tool to communicate with the world of conventional economics, not a view that reduces profound human, social and environmental values to monetary terms. It is a necessary step, given the dominance of the materialist ethic, in order to overcome the tendency to undervalue the services of unpaid labour, natural resources and other "free" assets; to make their contribution to prosperity clearly visible; and to bring these social and environmental assets more fully into the policy arena. Monetization also serves to demonstrate the linkages and connections between non-market and market factors, such as the reality that depletion of a natural resource will eventually produce an actual loss of value in the market economy. But monetary values should never be taken as a literal description of reality.

In order to separate ends from means, the first two GPI reports on the value of unpaid work presented time use valuations first as the basis of the secondary and dependent, monetary valuations. In the third GPI report, on costs of crime, crime rates were presented first as the basis of the secondary, dependent monetary valuation of the costs of crime. Similarly, in the natural resource and environmental accounts being released this year, physical accounts will always precede and form the basis for the subsequent monetary accounts. Secondary (derived) monetary values are always dependent on primary physical valuations and have no inherent reality in their own right. They should always be understood as simple strategies to bring neglected physical realities onto the policy agenda.

As the grip of market statistics on the policy arena is gradually loosened, the desired direction for the GPI is to return to the direct use of time, environmental quality and social indicators in decision making. This will also allow for greater accuracy and precision than relying on derivative economic values. For this reason, an ecological footprint analysis is included in the Nova Scotia GPI, even though it is the one component of the index in which no attempt at monetization is made. The use of land values is actually a far more direct method of assessing environmental impacts than the use of monetary values.

While the assignment of monetary values to non-market assets may appear absurd and even objectionable, society does accept court awards for grief and suffering and insurance company premiums on life and limbs as necessary measures to compensate actual human losses. We pay higher rents for dwellings with aesthetically pleasing views and we sell our time, labour and intelligence often to the highest bidder. Similarly, in a world where "everything has its price," monetizing social and environmental variables assigns them greater value in the policy arena and provides a more accurate measure of progress than excluding them from our central wealth accounts. For that reason, the other GPI components do use monetary values wherever possible.

Ultimately, however, it must be acknowledged that money is a poor tool for assessing the non-timber values of a forest, the costs of pollution or global warming, the value of caring work, the quality of education, or the fear, pain and suffering of a crime victim. A materialist criterion cannot adequately assign value to the non-material values that give life meaning.

Eventually, therefore, the Genuine Progress Index itself should give way to multi-dimensional policy analysis across a number of databases. New Zealand economist Marilyn Waring suggests a central triad of indicators – time use studies, qualitative environmental assessments and market statistics – as a comprehensive basis for assessing well-being and progress.[195]

In the meantime and only so long as market statistics dominate our economic thinking and our policy and planning processes, the GPI can provide a useful tool for communication between the

[195] Waring, Marilyn, 1998, "Women, Work and Wellbeing: A Global Perspective," address delivered at Kings College, Halifax, Nova Scotia, 30 April, 1998.

market and non-market sectors. By pointing to important linkages between the sectors, the GPI itself can provide a means to move beyond monetary assessments towards a more inclusive and integrated policy and planning framework.

Third, the Genuine Progress Index is not designed to be a final product, but it is a significant step in the direction of more comprehensive measures of progress than are currently in use. The GPI itself should be seen as a work in progress subject to continuous revision, improvement in methodologies and inclusion of additional variables. It will continue to evolve in form and content with further research, the development of new methods of measurement and the availability of improved data sources. Given these caveats, all interpretations and viewpoints expressed in this and other reports are designed to raise important issues for debate and discussion rather than as definitive or final conclusions or prescriptions.

For example, the GPI researchers have wrestled long and hard with definitions of "defensive expenditures" and the degree to which these might be interpreted in measures of progress negatively as surrogate values for damage incurred or as positive investments in environmental restoration. In other words, are *more* defensive expenditures are sign of progress or not? Or do the indicators of genuine progress themselves need to be based squarely on the physical indicators themselves and separated entirely from the secondary economic valuations?

High expenditures on restorative forestry are, for example, *both* a cost of prior excess and neglect *and* a positive sign that concerted efforts are being made to take necessary action. For this reason the actual quantity of defensive expenditures is not easily interpreted as a measure of progress and it is preferable to base such assessments and annual benchmarks on the core physical indicators which are the basis for subsequent economic cost-benefit analyses.

Similarly, much more work needs to be done on separating resource stock accounts from flow data like harvesting rates, and on distinguishing *relative* progress towards greater sustainability, which refers to changes in human activity, from a more absolute standard of sustainability based on nature's own balance and capacity to support human activity. For example, attainment of the internationally agreed Kyoto targets, a sure sign of *relative* progress, will not prevent the further atmospheric accumulation of greenhouse gases or the acceleration of global warming trends. The more absolute standards require difficult assessments of sustainability thresholds and ecosystem "carrying capacity." Wackernagel and Rees have made that leap towards assessments of global carrying capacity in constructing the ecological footprint paradigm. But they admit that their analysis does not include several key elements, including the sustainability of current harvesting *methods*.

Rather than offering any pretence of definitive answer to these challenging questions, GPI Atlantic hopes that its natural resource and environmental quality accounts stimulate further productive debate among researchers that will allow for every greater clarity and accuracy in future updates of the GPI work. In sum, GPI Atlantic is not wedded to any particular method of measurement or to any final assessment of results, but seeks to improve both its accounting methodologies and the accuracy of its results over time in accord with the constructive feedback its work receives.

Fourth and finally, it must be stated that the economic valuations are not precise. Any attempt to move beyond simple quantitative market statistics to the valuation of goods and services that are not exchanged for money in the market economy will produce considerable uncertainty. In the GPI report on the economic value of unpaid household work, for example, six different valuation methods were compared, each producing different aggregates. In the GPI *Cost of Crime* report, a range of cost estimates was presented from the most conservative measurements to more comprehensive estimates that included costs of unreported crimes; retail "shrinkage"; losses of unpaid production; and suffering of crime victims. The GPI *Greenhouse Gas Accounts* and the cost-benefit case study in the GPI *Water Quality Accounts* similarly presented a range of values based both on different discount rates and on high and low-end estimates of projected changes in climate, tourism, property values and a wide range of other variables.

This problem of precision is particularly acute in the natural resource accounts, with attempts to place an economic value on ecological services and the non-market functions of natural assets. For example, there is no doubt that water bodies, wetlands and forest watersheds provide vitally important functions to human society, including waste and nutrient cycling; erosion, flood and storm control; recreation; water filtration and purification; and food production and that these functions have vital economic value. But these functions have so long been accepted as "free," that any diminution of functional capacity has gone unrecorded in standard accounting procedures that track only market transactions in which money is exchanged.

How then, are such functions to be valued? Clearly a reduced natural nutrient or waste cycling capacity in a water body as a result of nutrient or waste overload, will have to be replaced by waste treatment upgrades that compensate for the loss of "free" ecological services, if water quality is to be maintained. In its recently released Water Quality report, GPI Atlantic used the capital costs of engineering upgrades as a surrogate value for the cost of lost nutrient cycling capacity. But should the operating costs of the replacement facility also be included? These difficulties are vastly accentuated in the GPI forest account, for example, in estimating the potential climate change damage costs from a loss of forest carbon sequestration capacity, because of the great difficulty in estimating the local impacts of global trends and global impacts of local forest practices.

Throughout the GPI environmental and resource accounts, there are many such difficult valuation choices and the GPI valuations are based on the author's best understanding of the available scientific and economic assessments. These few examples suffice to demonstrate that any economic assessment of natural resource values, or costs of natural capital depreciation, cannot pretend to be precise.

What the GPI Can Contribute

Despite all these major qualifications, it is finally important not to throw the baby out with the bath water! The GPI is in its earliest stages of development, but it is still considerably *more* accurate to assign explicit economic value to unpaid production, natural capital and other social and environmental assets than to assign them an arbitrary value of zero, as is currently the case in our conventional economic accounting system. And it is far *more* precise to recognize natural resource depletion and crime, sickness and pollution costs as economic liabilities rather than to count them as contributions to a more "robust" economy and to social progress, as is presently done.

Though the potential environmental impacts of current consumption practices are extraordinarily difficult to estimate, and though the web of cause-effect relationships is infinitely complex, it would be utterly foolhardy to deny the reality of these relationships or to pretend that costs will not be incurred. While it is very important to improve on the precision and methodologies of natural resource accounting and of social and environmental valuations, the current lack of precision should not be taken as an excuse for any delay in incorporating these mechanisms into our accounting systems. Efforts to value social and environmental assets, using the best available methodologies and data sources, still provide far greater accuracy and precision than continued reliance on an accounting system and measure of progress that gives *no* value to these assets and counts their depletion as gain.

In the long run, the GPI is intended as one step towards greater "full cost accounting" both in our core national and provincial accounts and as the basis for taxation and financial policy that will ultimately enable market prices themselves to reflect the full values and costs of embodied resources. The transition from externalized to internalized costs, from non-market to market valuations and from fixed to variable pricing mechanisms are the three core principles of full cost accounting.

For example, the inclusion of climate change costs in gasoline, energy and road pricing can be far more effective in encouraging resource conservation than taxation systems based entirely on income rather than resource usage. Similarly, very high market pricing of old-growth lumber would reflect the wide range of valuable services provided by ancient forests and encourage their preservation. Incorporation of natural resource valuations into our core economic accounts is, therefore, the first essential step in improving the efficiency of market mechanisms so that they reflect the full range of social, economic and environmental benefits and costs of both production and consumption processes.

The Nova Scotia Genuine Progress Index is not an isolated effort, but part of a global movement to overcome the recognized flaws in our current measures of progress and to ensure a more sustainable future for our children and for the planet. Indeed, as we have seen, the new System of National Accounts, Canada's own international commitments, and the considerable advances of recent years in developing expanded measures of progress, require that further efforts be made to integrate social, economic and environmental variables in our accounting mechanisms. The costs of continuing to ignore our social and environmental assets are too great. We have learned the hard way that measuring our progress in strictly materialist terms and without reference to our natural environment, which is the source of all life and of human survival, ultimately undermines well-being and prosperity.

In sum and with all its limitations, the GPI is a substantial step towards measuring sustainable development more precisely than prevailing accounts are able to do. It is itself a work in progress designed to help lay the foundations for the new economy of the 21st century, an economy that will genuinely reflect the social, spiritual, environmental and human values of our society.

Nova Scotia GPI: Release of Natural Resource Accounts, 2001

This particular report is one of several Nova Scotia GPI natural resource and environmental accounts to be released in 2001, on which research has been ongoing for the past three years. The first of these resource accounts, the *GPI Water Quality Accounts,* was released in July, 2000. In addition to this ecological footprint analysis, GPI Atlantic will also release its forest and greenhouse gas accounts; resource accounts for fisheries and for soils and agriculture; the GPI air quality component; and the first stage of a sustainable transportation analysis that applies full-cost accounting principles to a comparison of different modes of transportation. These reports will all be released during 2001, if funding permits. Later this year, GPI Atlantic will hopes to release its solid waste component.

This release of data on the health of Nova Scotia's natural resources and on the province's environmental quality, follows the release of several social accounts. These included full reports on the economic value of civic and voluntary work and on the economic value of unpaid housework and child care, released in July and November, 1998, with voluntary work updates released in February, 1999 and February, 2000. Those two studies measured important economic assets that are hidden and unvalued in our current accounting system and demonstrated that unpaid voluntary work and household production provide critically important services to society that are an essential precondition for a healthy market economy. The studies also showed that any deterioration in these sectors directly affects the standard of living and quality of life and has serious repercussions for the market economy.

The third GPI data release, in April, 1999, laid the groundwork for these natural resource accounts, by challenging the conventional economic growth paradigm, in which "more" is always assumed to be "better." GPI Atlantic's *Cost of Crime* report showed clearly that growth in and of itself does not necessarily signify an improvement in well-being and that this simplistic, prevailing assumption can mislead policy makers and skew the policy agenda. The contrast between the *Cost of Crime* report and the first two reports on the value of unpaid work, is therefore a useful illustration of Simon Kuznets' dictum that "goals for ‘more' growth should specify of what and for what."

While higher crime rates produce more spending on prisons, police, burglar alarms and theft insurance, all of which make the GDP grow, crime clearly diminishes the quality of life and diverts precious economic resources from health, education and other activities that enhance human and social welfare. In the GPI, as discussed earlier, "less" is frequently "better." Unlike the signals emanating form the GDP, in which growth of any kind signifies "progress" and a "stronger" and more "robust" economy, it was pointed above that the GPI counts *less* pollution, crime, sickness, fossil fuel combustion and natural resource depletion as signs of genuine progress. *The Cost of Crime* was the first GPI report to demonstrate that principle which applies equally to natural resource depletion.

In the last twelve months, GPI Atlantic has also released the first four indicator sets of its population health component, an assessment of *Women's Health in Atlantic Canada,* and reports on the costs of obesity, tobacco, and AIDS. It was demonstrated, for example, that obesity costs the Nova Scotia health care system $120 million a year in direct costs and a further $140 million annually in lost productivity, while tobacco costs the economy more than $400 million a year. Though sickness produces more spending on doctors, hospitals and drugs, all of which make the GDP grow, the GPI recognizes *less* sickness and improved population health as a core indicator of genuine progress.

While the next few months will see GPI Atlantic focussing primarily on the release of its natural resource and environmental accounts, there will be ongoing work by GPI researchers in the coming months on other social and economic components of the Genuine Progress Index, including income distribution, employment and work hours, the value of leisure time and on other health indicators. If funding permits and if research proceeds on schedule, there will be further data releases in these areas in the coming year.

Investment in Renewable Resources

The previous GPI data releases to date help establish a context for this present report and for the other environmental and natural resource accounts that follow. Just as crime signifies the deterioration of a social capital asset (a peaceful and secure society), so a decline in environmental quality or the depletion of natural resource wealth signifies the deterioration or depreciation of an environmental asset. As noted above, the Genuine Progress Index treats natural, social and human capital in the way that the conventional accounts treat produced capital, assessing both the value of the services provided and depreciation over time.

If current consumption habits are unsustainable and if natural capital assets deteriorate in value, thereby threatening the continued provision of vital ecological, social and economic services, then a renewed investment in natural resource conservation is required in the same way that a factory owner must consider the repair or replacement of old or malfunctioning machinery. The major caveat to this analogy, as noted above, is that, unlike manufactured capital which always depreciates over time, there is no *inherent* reason for natural capital to depreciate in value, because it has the capacity for self-renewal. If used sustainably, the quality and value of natural capital can actually be maintained *without* additional investment.

That is a big "if," but the distinction must be borne in mind to overcome the dangerous prevalent assumption that accepts the decline in environmental quality as "inevitable," or assumes the infinite substitutability of manufactured for natural capital. Natural capital assets can, in effect, provide a range of ecological services indefinitely and even repair and replenish themselves, provided that depletion rates are within a sustainable range.

The notion of a "stable" climate or a "resilient" forest, for example, does not imply that climate never changes or that no timber harvesting occurs. Rather there is a natural range of forest succession and historical climate fluctuation and change that may now have been dramatically distorted as a result of human activity. On a global scale, the capacity of our natural capital assets to provide food, water, timber, energy and other vital resources to human societies for thousands of years and the balance between human activity and environmental sustainability have only recently been threatened by massive economic growth and over-consumption in the present century.

The need for re-investment in natural capital therefore literally signifies the *cost* of previous unsustainable use and of human activities that have previously failed to respect and understand the natural limits, cycles and balance that exist in the natural world. Unlike manufactured capital depreciation, which represents a drawing down on *past* and *present* resources, natural capital depreciation *also* represents a drawing down on *future* resources, because renewable natural assets potentially exist in a "brand-new" state indefinitely. Depleting these resources in the interests of present consumption therefore directly threatens the welfare of future generations.

For example, the marine environment and freshwater rivers and lakes are *inherently* capable of providing as stable a level of fish stocks for future generations as at any time in the past. The 80% decline in Atlantic salmon returns, described in the GPI Water Quality report, is therefore not only a present cost of unsustainable resource use and human excess, but also a cost that will be borne by our children and for many generations to come. The "re-investment" that future generations will have to make in forest and water restoration and in other forms of natural resource conservation, to ensure their own survival, is therefore a cost that they will bear as the price of actions by past and present generations. Because it literally takes hundreds of years to restore a clear-cut forest to its natural state, this displacement of cost burdens to future generations requires a very long-term perspective.

While the depreciation metaphor is useful to illustrate the concept of natural capital, this crucial distinction between manufactured and natural capital must always be kept in mind. Since produced capital depreciation is inevitable, further investment in manufactured capital can potentially *add* real value that enhances well-being and improves the standard of living and quality of life of future generations. By contrast, natural capital depreciation that requires further investment *always* signifies a prior *cost* incurred through previous excess or unsustainable use. Unsustainable human activity in effect defers investment costs to future generations, because sustainable use would allow the resource to regenerate naturally without further investment.

The Nova Scotia GPI: Next Steps

This brief overview establishes the context of this present report in the framework of past and ongoing work on the Genuine Progress Index. Altogether the Nova Scotia GPI will eventually consist of 22 components.[196] These components are listed in Appendix B. By the end of the year 2001, enough components of the GPI will be complete for any jurisdiction to adopt the index as an actual policy tool and strategy for sustainable development even without completion of all potential components.

GPI Atlantic will also continue to cooperate and work closely with other parallel efforts in Canada and throughout the world, including the new sustainable development indicators initiative of the National Round Table on the Environment and the Economy, the ongoing development of resource satellite accounts, total work accounts and the Index of Social Health at Statistics Canada, the Index of Economic Well-being developed by the Centre for Living Standards, the exploration of new health indicators by Health Canada, the ongoing pioneering

[196] The components of the Nova Scotia GPI are described in detail in the GPI Atlantic profile entitled *Measuring Sustainable Development* (updated March, 2000). Available at www.gpiatlantic.org.

work of Redefining Progress in the USA, the outstanding community indicators work in Newfoundland, the Quality of Life Indicators Project of the Canadian Policy Research Networks, and many other similar initiatives that share the goals and aspirations of GPI Atlantic. In fact, GPI Atlantic is represented on the Sustainable Development Indicators steering committee of the National Round Table, a process that will undoubtedly bring together and promote cooperation among the many synchronous indicator efforts currently under way.

As work develops, GPI Atlantic would welcome a formal national consultation to discuss the GPI results and their implications as well as the results of similar indicator projects, to review the methodologies and measurement tools in detail, to identify core indicators that can serve as annual benchmarks of progress, to make specific recommendations to fill data gaps necessary to maintain the index over time, and to explore the potential for aggregating particular indicator sets

In consultation with Statistics Canada and in the interests of policy relevance, it has been decided to adopt a sectoral "bottom up" approach to the Nova Scotia GPI, presenting as comprehensive a portrait as possible of each of the 22 components that comprise the Index. Wherever possible, as mentioned earlier, monetary values will continue to be imputed in order to demonstrate linkages between the market and non-market sectors of the economy, and to facilitate policy adoption and communication with more conventional economic approaches.

When this sectoral development is complete, aggregation will present a major challenge and it is anticipated that the final GPI will more likely consist of several sets of sub-indices, corresponding to the five-fold division of components listed below, rather than as a single aggregated "bottom line" index. Challenges will include the elimination of double-counting, the consideration of appropriate weighting mechanisms, and the identification of core indicators that will allow a more integrated Genuine Progress Index to assess progress towards overall sustainable development in the province. The construction of this more composite index will require intensive consultations with Statistics Canada staff, other government officials and independent experts, and is not a task GPI Atlantic plans to undertake alone.

While the initial construction of the index is complex and time-consuming, as these first reports demonstrate, the goal is that the final index be easy to maintain and update in future years, that the design enable ready comparability with other jurisdictions, and that results are presented with a view to practical policy relevance and application. Each report describes in detail the methodologies used to derive results, so that other provinces can more easily replicate the measurements. Each report also describes the data requirements necessary to maintain the index and points to existing data gaps, and each report also emphasizes major policy implications indicated by the findings. Upon completion, the Nova Scotia GPI should not be regarded as a final and rigid formula, but as a work in progress that will be constantly modified and refined to reflect improved methodologies and new approaches and data sources.

Finally, it should be mentioned that, alongside these national, provincial and regional efforts to establish macro-indicators of well-being and sustainable development, GPI Atlantic is also working with two Nova Scotia communities, in rural Kings County and Glace Bay in industrial Cape Breton, to develop genuine progress indicators at the local level. These community indicators can serve as highly useful tools for sustainable community development strategies by identifying local strengths and weaknesses and by suggesting practical policy initiatives to local planners, community groups and public officials to improve the well-being and quality of life within communities. These two projects, funded primarily by the National Crime Prevention Centre's Business Action Program and the Canadian Population Health Initiative, are also pilots that will provide practical tools for measuring genuine progress to communities throughout Canada.

That is the basic framework for this release of data for the Nova Scotia GPI ecological footprint analysis and for the GPI environmental quality and natural resource accounts as a whole. The more detailed background documents for the project, the completed modules of the index to date, including summaries and press releases, GPI newsletters, and a summary of this report are available to the public on the GPI web site at www.gpiatlantic.org. Information on upcoming reports and data releases will be posted on that web site and in the GPI newsletter as it becomes available. Subscriptions to the GPI newsletter are available by contacting info@gpiatlantic.org.

APPENDIX B
THE NOVA SCOTIA GENUINE PROGRESS INDEX: LIST OF COMPONENTS

Time Use:
- * Economic Value of Civic and Voluntary Work
- * Economic Value of Unpaid Housework and Childcare
- * Costs of Underemployment
- * Value of Leisure Time

Natural Capital:
- * Soils and Agriculture
- * Forests
- * Marine Environment/Fisheries
- * Nonrenewable Subsoil Assets

Environment:
- * Greenhouse Gas Emissions
- * Sustainable Transportation
- * Ecological Footprint Analysis
- * Air Quality
- * Water Quality
- * Solid Waste

Socioeconomic:
- * Income Distribution
- * Debt, External Borrowing and Capital Movements
- * Valuations of Durability
- * Composite Livelihood Security Index

Social Capital:
- * Health Care
- * Educational Attainment
- * Costs of Crime
- * Human Freedom Index