

S t a t e o f t h e D e b a t e

Environment and Sustainable Development Indicators for Canada

NRTEE  TRNEE

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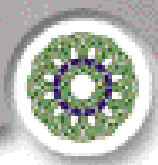
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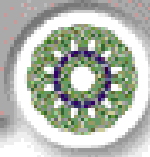
The National Round Table on the Environment and the Economy (NRTEE) was created to “play the role of catalyst in identifying, explaining and promoting, in all sectors of Canadian society and in all regions of Canada, principles and practices of sustainable development.” Specifically, the agency identifies issues that have both environmental and economic implications, explores these implications, and attempts to identify actions that will balance economic prosperity with environmental preservation.

At the heart of the NRTEE’s work is a commitment to improve the quality of economic and environmental policy development by providing decision makers with the information they need to make reasoned choices on a sustainable future for Canada. The agency seeks to carry out its mandate by:

- advising decision makers and opinion leaders on the best way to integrate environmental and economic considerations into decision making;
- actively seeking input from stakeholders with a vested interest in any particular issue and providing a neutral meeting ground where they can work to resolve issues and overcome barriers to sustainable development;
- analyzing environmental and economic facts to identify changes that will enhance sustainability in Canada; and
- using the products of research, analysis and national consultation to come to a conclusion on the state of the debate on the environment and the economy.

The NRTEE’s state of the debate reports synthesize the results of stakeholder consultations on potential opportunities for sustainable development. They summarize the extent of consensus and reasons for disagreement, review the consequences of action or inaction, and recommend steps specific stakeholders can take to promote sustainability.

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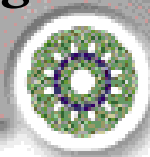
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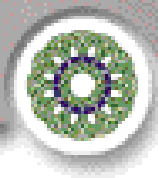
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Table of Contents

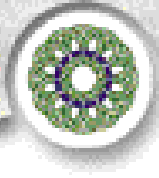


MANDATE	i
NRTEE MEMBERS	iii
ENVIRONMENT AND SUSTAINABLE DEVELOPMENT INDICATORS (ESDI) STEERING COMMITTEE	v
A NOTE FROM THE CHAIR	xi
MESSAGE FROM THE ESDI STEERING COMMITTEE CO-CHAIRS	xiii
EXECUTIVE SUMMARY	xv
I) National Natural and Human Capital Indicators	xviii
II) An Expanded System of National Accounts	xix
III) Improved Environmental Data	xix
IV) The State of the Debate	xx
V) Putting Recommendations into Action	xx
RECOMMENDATIONS	xxi
1. INTRODUCTION	1
1.1 Overview	3
1.2 The ESDI Initiative	4
2. CONTEXT	7
2.1 Why We Need Better Information	9
2.2 Related Initiatives	11
3. THE CAPITAL MODEL	13
The Four Types of Capital	15
4. NATIONAL INDICATORS OF NATURAL AND HUMAN CAPITAL	17
4.1 Natural Capital	19
4.2 Natural Capital 1: Air Quality Trend Indicator	21
4.2.1 Description of the Proposed Indicator	21
4.2.2 The Indicator Today	21
4.2.3 Rationale	22
4.2.4 Producing the Indicator and Future Improvements	23

4.3	Natural Capital 2: Freshwater Quality Indicator	23
4.3.1	Description of the Proposed Indicator	23
4.3.2	The Indicator Today	24
4.3.3	Rationale	24
4.3.4	Producing the Indicator and Future Improvements	25
4.4	Natural Capital 3: Greenhouse Gas Emissions Indicator	26
4.4.1	Description of the Proposed Indicator	26
4.4.2	The Indicator Today	26
4.4.3	Rationale	26
4.4.4	Producing the Indicator and Future Improvements	27
4.5	Natural Capital 4: Forest Cover Indicator	28
4.5.1	Description of the Proposed Indicator	28
4.5.2	The Indicator Today	29
4.5.3	Rationale	30
4.5.4	Producing the Indicator and Future Improvements	31
4.6	Natural Capital 5: Extent of Wetlands Indicator	32
4.6.1	Description of the Proposed Indicator	32
4.6.2	The Indicator Today	32
4.6.3	Rationale	33
4.6.4	Producing the Indicator and Future Improvements	34
4.7	Human Capital Indicator: Educational Attainment of the Working-Age Population	34
4.7.1	Description of the Proposed Indicator	35
4.7.2	Rationale	35
4.7.3	Producing the Indicator and Future Improvements	36
5.	A BETTER CAPITAL INFORMATION FRAMEWORK	37
5.1	Expanding the System of National Accounts	39
5.1.1	New Natural Capital Accounts	40
	Natural Capital Asset Stock Accounts	40
	Material and Energy Flow Accounts	42
	Environmental Protection Accounts	42
5.1.2	Human Capital Accounts	42
5.1.3	Social Capital Accounts	42
5.1.4	A National Wealth Indicator	43
5.2	Improving the Quantity and Quality of Environmental Information Available to Canadians	44
6.	THE STATE OF THE DEBATE	45
6.1	Summary of Areas of Agreement	47
6.2	A Single, Aggregated Indicator versus Various Representative Indicators	48
6.3	Which Indicators?	50

7. RECOMMENDED NEXT STEPS	51
7.1 First Steps: Report and Refine the Recommended Indicators	53
7.2 Longer-Term Actions	53
7.2.1 Expand and Reorient the System of National Accounts	53
7.2.2 Support CISE	54
7.2.3 Institutionalize the NRTEE's Recommendations	54
APPENDIX A	
ESDI Cluster Groups, September 2001 – February 2002	A 1
APPENDIX B	
Participants in Workshops with Potential Indicator Audiences	B 1
APPENDIX C	
Economists' Workshop, February 20, 2002	C 1
APPENDIX D	
Technical Assistance in the Development of the Final Indicators, July 2002 – February 2003	D 1
APPENDIX E	
Acknowledgements	E 1
Photo Credits	E 1
Endnotes	E 3

A Note from the Chair



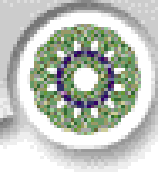
The National Round Table on the Environment and the Economy (NRTEE) undertook the Environment and Sustainable Development Indicators (ESDI) Initiative to develop a small suite of mostly new national-level indicators that take account of those assets that are necessary to sustain a healthy economy, society and environment for Canadians.

The development of these indicators is founded on the new economics that recognizes that the world's natural capital provides us with services that are crucial to society. These services include air and water purification, productive soils, climate regulation, flood control and crop pollination—services that are too often taken for granted but which, all would agree, have a value, and even an important one.

As Chair of the NRTEE, I am therefore pleased to present this report, which outlines a small set of indicators designed to supplement traditional macroeconomic indicators such as the gross domestic product. This document also underscores the need for good-quality information on the full range of Canada's important national assets, and sees a collaboration of federal departments such as Environment Canada and Statistics Canada, as well as provincial governments, as crucial for their development. The NRTEE realizes that expanding environmental monitoring and the System of National Accounts is a long-term endeavour. However, the recommendations flowing from the ESDI Initiative are a first step toward better recognizing the true value of our natural capital.

Harvey L. Mead
Chair, NRTEE

Message from the ESDI Steering Committee Co-Chairs



You manage only what you measure. The measurements our society uses to judge success, such as the gross domestic product, do not take into account the long-term implications of our current actions. In fact, many economic indicators fail to measure those factors on which we depend for continued quality of life, such as the services provided by the environment.

The Government of Canada recognized this anomaly in the 2000 federal budget, when it mandated the National Round Table on the Environment and the Economy (NRTEE) to develop a set of national indicators of environment and sustainable development. These indicators will track the impact of current economic practices on the natural and human assets that will be needed by future generations of Canadians.

Beyond the indicators themselves, we are enthusiastically recommending that Canada become a world leader in developing a revised System of National Accounts, which would include information on all types of capital, including natural and human. In addition, the NRTEE strongly supports the creation of a better national network to monitor Canada's environmental assets.

The NRTEE worked with key partners, such as Statistics Canada and Environment Canada, to create a multi-stakeholder process that would result in indicators that are few in number, technically robust, credible and easy to understand. Scientists, indicator researchers, non-governmental organizations, academics, officials from all levels of government, and representatives from business and financial organizations all helped in developing the recommendations presented in this report.

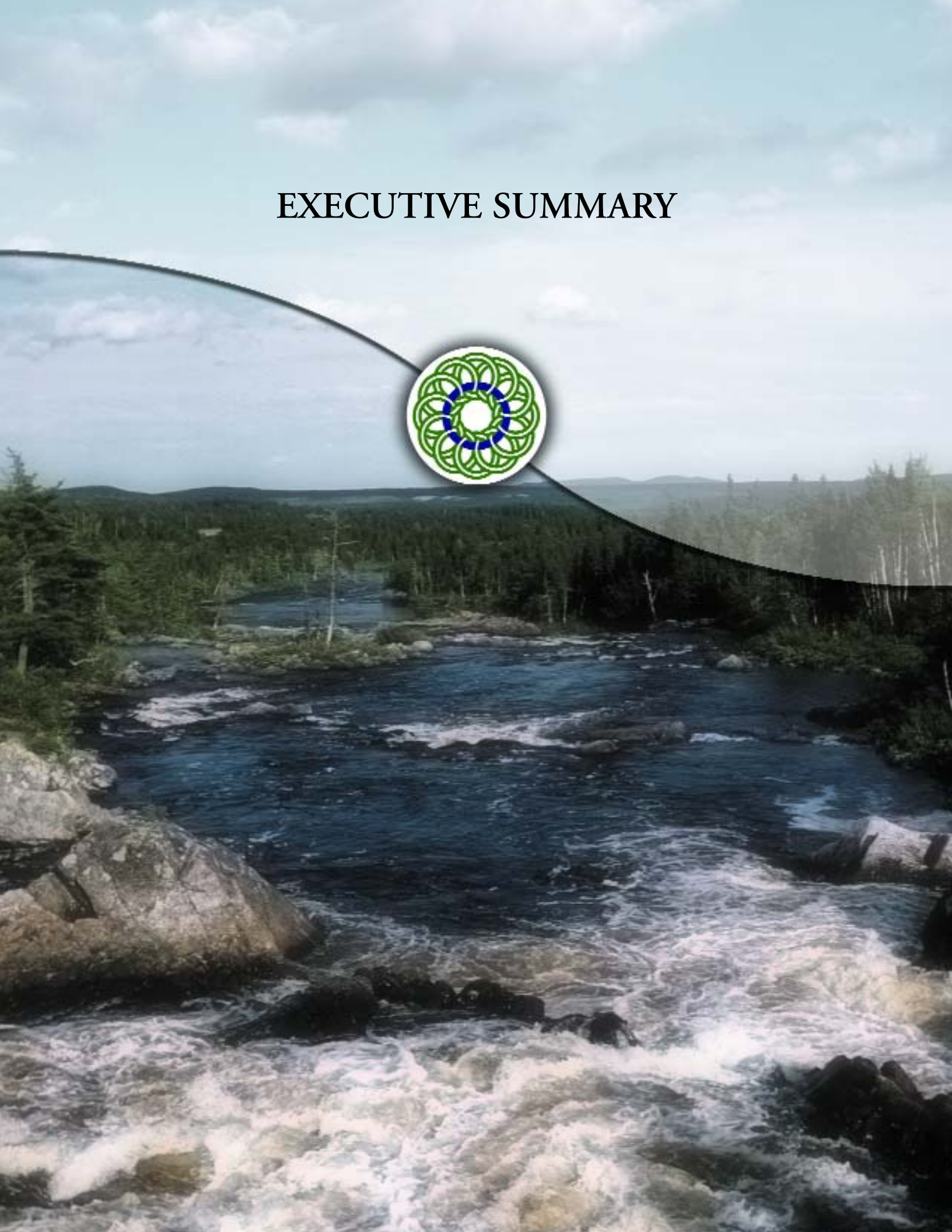
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EXECUTIVE SUMMARY





Executive Summary



The National Round Table on the Environment and the Economy (NRTEE) undertook the Environment and Sustainable Development Indicators (ESDI) Initiative to find ways to track the impact of current economic practices on the natural and human assets that will be needed by future generations of Canadians. Observing that “we must come to grips with the fact that the current means of measuring progress are inadequate,” the Minister of Finance announced the ESDI Initiative in the 2000 spring budget. He stated that the indicators developed by this initiative “could well have a greater impact on public policy than any other single measure we might introduce.”

The ESDI Initiative was built on the need for our national-level indicators and information systems to take better account of those assets that are necessary to sustain a dynamic economy and a healthy society and environment for Canadians. These assets represent the nation’s “capital,” an economic term first used to designate entities such as buildings and equipment that enable future economic production. The recommendations in this report are based on the notion that other types of capital—such as the environmental assets that provide the “services” that make life possible—are at least as important to the future economy as factories and machinery. To ensure development opportunities for future generations, Canada needs to track and consider all these important types of capital in making economic decisions. Otherwise we risk significantly depleting key human and natural assets without even being aware of it. Similarly, we risk under investing in assets that may be important for future development opportunities.

The NRTEE has concluded that, at present, Canada’s national information systems do not provide data on the full range of Canada’s national capital assets or on the various linkages among environmental, social and economic factors. Canada, like most other countries, relies on various macroeconomic indicators—such as the gross domestic product (GDP)—as well as a System of National Accounts (SNA) to support national-level decision making on economic development. Currently, most economic indicators and the SNA provide little information about natural, human or social capital. As such, they provide only a partial view of the factors that affect development, and they

do not account for the true and full costs and benefits of economic decisions. For instance, they ignore the full cost of paving over fields and burning fossil fuels.

To remedy this asymmetry in the availability of information, the NRTEE has produced a small set of easily understood indicators to track additional factors of importance to Canadians. These new indicators have been designed to supplement and provide context for macroeconomic indicators such as the GDP, but not to change them. The NRTEE recommends that Statistics Canada publish these new indicators annually, and that the Minister of Finance incorporate them in the federal budget statement. This step will provide Canadians with a better context for understanding the state and potential of our economy.

In addition, the NRTEE has identified a need for good-quality information on the full range of important national assets. It therefore recommends both improving and expanding the data structures and information systems required to report on national capital. Specifically, it proposes that the federal government expand, in a stepwise manner, the System of National Accounts to include new accounts covering natural, human and social capital. Further, it recommends investment in improved monitoring and information systems to overcome the paucity of good-quality, national-level information on environmental issues.

I) NATIONAL NATURAL AND HUMAN CAPITAL INDICATORS

Supplementing existing economic indicators with the following small set of new indicators will provide Canadians with a more robust picture of the state of our national capital. Like economic indicators, these indicators do not give the full picture. Rather, they illustrate some aspects of Canada's natural and human capital. Five of the six recommended indicators have been calculated for this report, although several are in a preliminary form.

Air Quality Trend Indicator—tracks the exposure of Canadians to a particularly harmful type of air pollutant—ground-level ozone (O₃). This indicator is the first readily available Canadian measure of air quality that weights exposure to a pollutant by population. In other words, this indicator tries to factor in the number of people who are exposed to low-level ozone, as well as the ambient concentrations of ozone in different parts of the country.

Freshwater Quality Indicator—provides a national measure of the overall state of water quality as measured against major objectives for water use in Canada (such as water for drinking, aquatic life habitat, recreation and agriculture). The indicator will show whether water quality is impaired to the extent that water quality objectives are not being met for these water uses. It will be based on aggregated data from existing provincial-level water quality indices, most of which are calculated using the Canadian Council of Ministers of the Environment (CCME)'s methodology. The indicator will show the proportion of water bodies in the existing monitoring networks that are classified as “marginal” or “poor.”

Greenhouse Gas Emissions Indicator—tracks Canada's total annual emissions of greenhouse gases, including carbon dioxide (CO₂), methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride. Based on the existing national greenhouse gas inventory developed by Environment Canada, the indicator measures aggregate emissions of these gases in megatonnes of CO₂ equivalent. This indicator, already developed by Environment Canada, will help Canadians track their progress in helping to address climate change.

Forest Cover Indicator—tracks changes in the extent of Canada's forests. This indicator represents a new use for existing satellite data and will provide the only regularly updated national indicator of forest cover.

Extent of Wetlands Indicator—tracks changes in the total area of wetlands in Canada. This is the only indicator that cannot be calculated at present, since time-series data on wetlands for the full country do not yet exist. The indicator has nonetheless been recommended due to the importance of wetlands, which support substantial economic activity and are good proxies for the overall condition of our biodiversity. The development of a robust national indicator, based on remote-sensing data, will require approximately two years.

Human Capital Indicator (Educational Attainment)—tracks the percentage of the workforce population with educational qualifications beyond the secondary school level. It measures the percentage of the Canadian population aged 25 to 64 years who have upper-secondary (e.g. vocational or apprenticeship training) and tertiary-level (e.g. community college, CEGEP or university) educational qualifications. Human capital refers to the “knowledge, skills, competencies and attributes embodied in individuals that facilitate the creation of personal, social and economic well-being.” This indicator will reveal our investment trend in an important aspect of human capital—a well-educated workforce—and will help us understand our ability to compete in a global, knowledge-based economy.

II) AN EXPANDED SYSTEM OF NATIONAL ACCOUNTS

The System of National Accounts serves as the basis for most of our important macroeconomic indicators, including the GDP. As such, it provides the most widely used framework for analysis of the Canadian economy. To support the new indicators of national capital, and to provide comprehensive information about Canada’s capital assets, the NRTEE recommends extending the SNA to include measures of natural, human and social capital.

Extending the SNA will allow measurement of our overall base of capital assets, and will help clarify linkages between environmental, social and economic factors. It will provide a more

complete picture of the state of, and changes in, Canada’s total wealth, as well as support more informed decision making on a wide range of issues.

A comprehensive extension of the SNA to provide a robust set of data covering each of the main types of capital will require years of effort. However, it should be pursued actively as a long-term objective to support the ongoing development of a strong, innovative Canadian economy. This work will build on steps already taken by Statistics Canada in the 1990s to develop selected accounts on natural capital, such as subsoil mineral assets.

III) IMPROVED ENVIRONMENTAL DATA

Data availability is the third crucial element of the recommendations resulting from the ESDI Initiative. Much of Canada’s environmental information is incomplete and of surprisingly poor quality in some areas. Environmental information collected in different parts of the country is not comparable or consistent in many cases. There are very few nationwide databases that are regularly updated, even for basic environmental matters such as water quality. As a result, few regularly updated national indicators are possible, because of a lack of corresponding information systems.

Further progress on national-level reporting will require substantial resources in the form of stable and ongoing funding for the Canadian Information System for the Environment (CISE). It will also require improved partnerships among all levels of government and between governmental and non-governmental organizations. The objective is to collect appropriate information, share it and make it accessible to all Canadians. This information is needed for national-level reporting, and is essential if government and the public are to make informed decisions on environmental and natural resource management issues.

IV) THE STATE OF THE DEBATE

Despite various and inevitable methodological and philosophical disagreements about precisely what and how to measure, most participants agreed that the proposed indicators—of air quality, water quality, greenhouse gas emissions, forest cover, extent of wetlands and educational attainment—all provide important information for Canadians that can be linked to economic activity.

Several important areas of disagreement did arise, however. One of the most contentious issues was whether and how to aggregate information about Canada's overall capital. Much of the discussion here focused on the prospects for developing an aggregated, monetized indicator of the net value of national capital. The benefits of a single, aggregated indicator of national sustainability were weighed against the difficulty of monetizing all types of capital.

More fundamentally, an aggregated indicator is only appropriate if it can be assumed that all types of capital can be substituted for one another and that this is desirable. Because of the controversial nature of this issue, prudence dictates that Canada's information system not assume that all forms of capital are entirely substitutable. Accordingly, the ESDI model includes discrete indicators of some aspects of human and natural capital. The extended SNA will provide the basis both for tracking a broader set of capital assets and for developing an aggregate measure of selected types of capital whose stocks and benefits can be credibly converted to monetary values.

There was widespread support among the participants in the ESDI Initiative for developing indicators based on a capital model to address intergenerational equity issues. Several participants, however, felt strongly that there should have been greater emphasis on measurement of intragenerational equity.

Various participants also argued that the set of ESDI indicators should provide information in addition to that on the state of capital stocks.

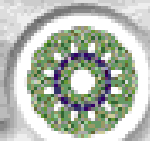
Because broad indicators such as overall forest cover failed to reveal important qualitative data, some felt strongly that more detailed indicators were required. Also, some program participants recommended including information about the "pressures" faced by the various stocks of natural capital. Some also supported a consumption indicator such as the "ecological footprint." This type of indicator would inform Canadians about the environmental impact, for example, of their driving habits, energy use, consumption patterns, waste production and other types of behaviour.

V) PUTTING RECOMMENDATIONS INTO ACTION

The timely and effective implementation of the recommendations presented in this report will require the active involvement of many organizations at all levels within Canadian society. The recommendations range from the short term (i.e. most indicators) to the longer term (i.e. the extension of the SNA to cover three new types of capital and link them to existing economic accounts). Although the NRTEE is handing over these recommendations to the federal government for implementation, it will make a concerted effort over the next year to promote the implementation of its recommendations, and to sensitize both the informed public and decision makers regarding the use of the indicators and the value of a broader approach to national accounting and environmental monitoring.

The NRTEE recommends that the Department of Finance take the lead role in committing to use the proposed indicators and in helping to shape priorities for the evolution of the SNA. Statistics Canada has committed to play the lead role in reporting the recommended indicators annually and, when properly resourced, to developing the System of National Accounts to cover the full range of capital assets. Environment Canada has committed to implement the Canadian Information System for the Environment.

Recommendations



The NRTEE's ESDI Initiative has resulted in recommendations in three broad areas. The first area of recommendations relates to the immediate need to report on a small set of illustrative indicators that link national natural and human capital to economic factors. The second and third areas focus on medium- to long-term improvements in the national analytical framework and information base that will encourage sustainable development. The three main areas of recommendations are summarized in the following text.

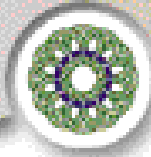
- 1. Report annually a small set of new, national-level natural and human capital indicators.** The NRTEE recommends that Statistics Canada publish annually six easily understood, credible indicators in two broad areas:
 - Natural capital
 - Air Quality Trend Indicator
 - Freshwater Quality Indicator
 - Greenhouse Gas Emissions Indicator
 - Forest Cover Indicator
 - Extent of Wetlands Indicator, and
 - Human capital: Educational AttainmentIt further recommends that the Minister of Finance incorporate these indicators into the federal budget statement to complement existing economic indicators.
- 2. Expand the System of National Accounts.** The NRTEE recommends that the Government of Canada expand the System of National Accounts to include more detailed information on natural, human and, over time, social capital. It will be important, as well, to complement the above small set of natural and human capital indicators with a more complete national accounting system. This will provide comprehensive information about Canada's capital assets as the basis for future development of the country and for maintenance of our social well-being and environmental health.
 - 3. Improve national environmental information systems.** The NRTEE recommends that the Government of Canada work with all levels of government to improve the quantity and quality of environmental information. The Canadian Information System for the Environment should play a central role in coordinating the provision of this information.

Chapter One
INTRODUCTION





Introduction



1.1 OVERVIEW

The Environment and Sustainable Development Indicators (ESDI) Initiative has been an effort to track, at the national level, the impact of current economic practices on the natural and human assets that will be needed by future generations of Canadians. Observing that “we must come to grips with the fact that the current means of measuring progress are inadequate,” the Minister of Finance announced the ESDI Initiative in the 2000 spring budget. He stated that the indicators developed by this initiative “could well have a greater impact on public policy than any other single measure we might introduce.”

The basic premise adopted by the National Round Table on the Environment and the Economy (NRTEE) in carrying out the ESDI Initiative is that our society must take better account of those assets that will be necessary to sustain a healthy society and economy. These assets represent the nation’s “capital,” an economic term first used to designate entities such as buildings and equipment that assured economic production in the future. The NRTEE’s recommendations rest on the notion that other types of capital—such as the environmental assets that provide the “services” that make life possible—are at least as important to the future economy as factories and machinery. Canada must start to explicitly track and include consideration of all the key types of capital in economic decisions.

Put another way, the NRTEE has concluded that the current focus of most of our economic indicators on current production should be balanced with an increased emphasis on wealth, where wealth is a broader concept that

encompasses the basis for generating production now and in the future. Achieving this goal will require significant improvements in the types of information collected at the national level, particularly with respect to Canada’s natural capital (which includes environmental aspects) and our human and social capital.

Without a system to track all types of important capital, we risk significantly depleting important assets without even realizing it. Moreover, we do not account for the true and full costs and benefits of economic decisions. For instance, we have not yet learned to count the full cost of actions such as paving over fields or burning fossil fuels. A primary purpose of the system of national indicators and information systems presented here is to remedy this asymmetry in the availability of information.

The NRTEE was asked to develop a small set of easily understood national environment and sustainable development indicators, using the input of a broad range of stakeholders and experts. Therefore, the first broad area of recommendations relates to the regular reporting of selected indicators for natural and human capital. The indicators’ role is to complement the macroeconomic indicators that currently help summarize the state of the national economy. The NRTEE proposes that the indicators be published annually by Statistics Canada and incorporated by the Department of Finance into the federal budget statement.

The remaining two areas of recommendations go beyond the topic of indicators to address improvements to the crucially important data structures and information systems that are necessary to reporting on a broader range of

capital. On the one hand, the NRTEE is calling for the creation of a solid analytical basis for incorporating longer-term factors into economic decision making, by expanding Canada's System of National Accounts (SNA). The expanded SNA would include new accounts on previously overlooked types of capital—natural, human and, eventually, social. On the other hand, the lack of high-quality information on these types of capital has prompted the NRTEE to strongly recommend greater monitoring and better information systems, particularly with regard to environmental issues.

This report presents the conclusions and recommendations arising from the ESDI Initiative. Sections 2 and 3 describe the context for the recommendations, including the reasons why Canada needs an expanded information base to supplement economic indicators such as the gross domestic product (section 2), and a description of the capital model on which the NRTEE's recommendations are based (section 3). Sections 4 and 5 describe the indicators and the information-related recommendations, respectively. Section 6 reviews the various important issues that are still under debate regarding important but difficult issues related to environment and sustainable development indicators. Finally, Section 7 concludes with an outline of the recommended next steps.

1.2 THE ESDI INITIATIVE

To lead the ESDI Initiative, the NRTEE assembled a 30-member Steering Committee (see pages v, vi). Members included representatives from organizations involved in developing indicators of sustainability, non-governmental organizations, academics, government officials, and representatives from business and financial organizations.

From the outset, the NRTEE collaborated closely with Statistics Canada and Environment Canada to ensure the credibility and applicability of its recommendations and proposed indicators.

Important criteria for selecting the indicators were that they be clear, transparent, as unambiguous as possible, and scientifically credible. Therefore, many different individuals participated in helping to identify and develop the indicators and in commenting on draft recommendations. Included in the indicator selection process were potential audiences for, and users of, these indicators, as well as many experts in indicator development. Participants in the process are listed in Appendices A to D.

The ESDI Initiative unfolded in three phases:¹

- Phase 1 (September 2000 to March 2001) focused on the development of the overall capital model on which to base the indicators. Activities during this phase included reviews of existing work in the area. As well, the NRTEE convened the first National Conference on Sustainable Development Indicators and a workshop for potential audiences (March 27 and 28, 2001) to review the proposed capital framework.
- Phase 2 (April 2001 to June 2002) was devoted to developing suitable indicators. Much of this work was conducted by advisory "cluster groups" of experts, who focused on identifying possible indicators of natural and human capital. From this list of indicators, the ESDI Steering Committee selected a core set of draft indicators and started to develop its recommendations to extend the System of National Accounts.

As well, the NRTEE convened a second national conference and workshop for potential audiences (June 19 and 20, 2002) to review the proposed indicators. Following these events, the Steering Committee refined its recommendations.

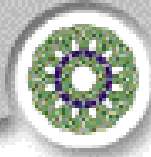
- Phase 3 (July 2002 to March 2003) involved further review of the recommendations, technical refinement of the proposed indicators, and the detailed development of long-term recommendations linked to data collection and reporting.

This report reflects the views of the ESDI Steering Committee and the NRTEE. It includes recommendations as well as a discussion of issues that remained unresolved. Following delivery of this report to the government, the Minister of the Environment will be asked to report to Cabinet with advice on an appropriate government response to the recommendations.

Chapter Two
CONTEXT







2.1 WHY WE NEED BETTER INFORMATION

Determining whether society is on a desired course requires a measurement system that supplies decision makers with the signals they need to make effective choices. Indicators represent an important part of such a system because they summarize significant information about complex systems.

The Minister of Finance instigated the ESDI Initiative because of widespread agreement in Canada and elsewhere that the national-level, macroeconomic indicators currently in use to judge a society's success provide only part of the information needed: they exclude many of the factors on which we depend for continued development as a society, particularly the services provided by a clean environment and by our education system. Moreover, macroeconomic indicators emphasize current income rather than wealth, but it is the latter that is the basis for generating income in the future. By neglecting the needs of future generations, macroeconomic indicators ignore the main concern of sustainable development. The NRTEE hopes that, by expressing the concern for intergenerational equity in terms of "capital," it can provide a link to the economic issues that are the purview of the Minister of Finance.

The limitations of the commonly used indicators are highlighted by the example of the gross domestic product (GDP). For the past 50 years, the GDP has been the main national measure used by decision makers and the informed public alike to understand national economic performance. The GDP measures the total monetary value of the transactions that occur within the formal marketplace. As such, it provides only a partial view of the factors that affect development. It excludes, for example, the benefits associated with the work of volunteers and the services provided freely by the environment (such as protection from ultraviolet radiation). Moreover, because it is designed as a measure of total economic activity, the GDP indiscriminately includes as a positive contribution every market transaction, even the regrettable costs of treating a child for an asthma attack caused by polluted city air. The GDP was not designed to act as a summary indicator of the overall progress of a society, but that is often how it is used.

The first objective of the ESDI Initiative was to address the limitations to macroeconomic indicators such as the GDP by developing new indicators that would track some of the additional factors that are of importance to Canadians. These new indicators have been designed to supplement and provide context for macroeconomic indicators, but not to change them.

A second goal for the ESDI Initiative was to extend the System of National Accounts. These accounts provide information needed to support economic analysis and development decisions, and the GDP is one of the many indicators derived from them. The SNA pertains solely to current transactions that are valued in monetary terms. As such, the accounts cannot be used to analyze the benefits associated with activities that occur outside the marketplace. For instance, they do not account for the value of the numerous ecosystem services for which no one pays directly, or for the impacts of pollution.

Equally important, the national accounts take a narrow view of expenditures on human development and related “intangible” outlays, treating them as current consumption expenditures rather than investments. Under a broader view, they would be seen as investments in human capital that can raise economic output and incomes in the future. Like the recommended indicators, the proposed extension of the System of National Accounts will not affect the way the GDP is calculated or its underlying databases.

Data availability is the third crucial piece of the vision proposed by the ESDI Initiative. The NRTEE found the quality of environmental information to be highly varied and its availability patchy. Two problems often emerged. The first was the lack of nationally consistent databases, resulting in little comparability between information collected in different parts of the country and a limited ability to aggregate the data on a countrywide basis.

The second problem was linked to the paucity of relevant time series, with gaps of years existing in the monitoring records of some key environmental quality factors, such as water quality. In other words, few regularly updated national indicators are possible, because of a lack of corresponding information systems.

In this context, progress toward national-level reporting on important types of capital will depend on increased environmental monitoring, as well as improved partnerships among all levels of government and among governmental and non-governmental organizations.

The development of these partnerships to create a more nationally consistent environmental information system is one of the main goals of the Canadian Information System for the Environment (CISE). The purpose of CISE is to catalyze the creation of a system that collects appropriate information, shares it, and makes it accessible to all Canadians. Such information is needed for national-level “macro” reporting, as well as to enable the federal and provincial governments to manage their environmental and natural resources mandates.

The ESDI Initiative has resulted in recommendations on a set of illustrative indicators that will better link issues of environment and economy. These indicators are part of a long-term vision that has been developed to provide a better analytical framework for encouraging sustainable development. This vision includes three main components:

1. National indicators of natural and human capital: The NRTEE recommends that the Government of Canada generate and report annually on the small set of illustrative, easily understood, credible indicators of natural and human capital as described in this report. These will supplement existing economic indicators, such as the GDP and employment rates.

2. An expanded System of National Accounts: The NRTEE recommends the creation of detailed, disaggregated accounts to support the proposed small set of natural and human capital indicators. These accounts (rather like the detailed economic accounts supporting the GDP) would be included in, and compatible with, the existing System of National Accounts. In addition, in order to provide comprehensive information about Canada's capital assets, the NRTEE proposes that the Government of Canada work to expand the SNA beyond the areas represented by the indicators, so as to include detailed information on all types of natural, human and—ultimately—social capital.

3. Better national environmental information: The NRTEE recommends that the Government of Canada work with all departments with relevant mandates and all levels of government to improve the quantity and quality of national-level environmental information. In particular, regularly updated national information on various aspects of natural capital is weak. The NRTEE proposes that the Canadian Information System for the Environment play a central role in coordinating the provision of this information.

2.2 RELATED INITIATIVES

The ESDI Initiative has benefited from, and built on, the significant activity taking place in Canada and internationally to develop new approaches to environment and sustainable development indicators. For example, the NRTEE has engaged and supported a number of expert groups and organizations working on these issues in Canada. These efforts have highlighted the fact that many levels of government, businesses and non-governmental organizations are developing new means to assess, and report on, progress toward various aspects of sustainable development.

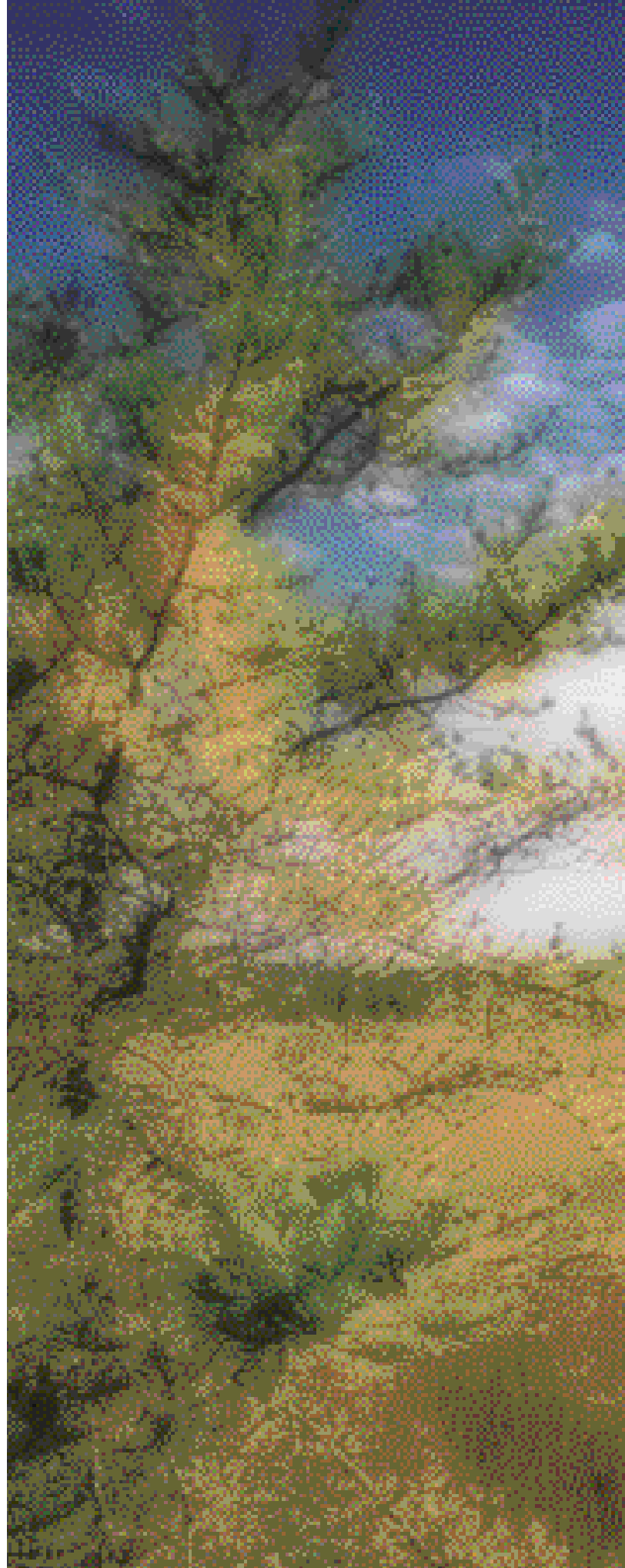
Different information initiatives are designed to achieve different goals. Some, such as the one spearheaded by the Fraser Basin Council, focus on the regional or community level to track the links between the health of residents, the state of local ecosystems and the state of the regional economy. Others are working to evaluate the impact of a wide range of social and environmental factors at the provincial level. This is the goal of two Canadian initiatives—the Alberta Genuine Progress Indicator Accounting Project as developed by the Pembina Institute for Appropriate Development, and efforts by GPI Atlantic to calculate various aspects of genuine progress for Nova Scotia.

Some initiatives are international in scope. The World Bank's ongoing work on the "wealth of nations" and the World Economic Forum's Environmental Sustainability Index represent different approaches to comparing countries based on a range of economic, environmental and social factors. The first approach focuses on monetizing key types of capital; the second concentrates on weighting and aggregating a broad range of environmental sustainability indicators based on various types of physical units.

A few initiatives have a different starting point. Instead of tracking the sustainability of our development path, initiatives such as the Canadian Policy Research Network's Quality of Life Indicators Project (QOLIP) focus on measuring the existing quality of life or well-being. These initiatives often feature consultation and dialogue with citizens to determine what they consider important for assessing quality of life in Canada, and to discuss the broad range of complex factors that contribute to that assessment.

Many initiatives do not try to cover the entire scope of sustainable development but focus instead on a particular aspect. Within the federal government, various departments have ongoing projects to develop sustainable development indicators related to their own mandates. For example, Natural Resources Canada has been developing national indicators in the forest, energy and minerals sectors; Environment Canada has been developing national indicators that track selected environmental issues; Agriculture and Agri-Food Canada has created indicators of environmental sustainability for agriculture, and the Department of Fisheries and Oceans has been looking at a range of measures for widely distributed, complex marine biological resources. Also, several provincial governments (i.e. Alberta, British Columbia, Manitoba and Saskatchewan) are developing environment and sustainable development indicators at the provincial scale.

The NRTEE has drawn heavily on many of the methodologies, data sets and approaches already developed. However, it was assigned a specific mandate that defined its approach to indicators. Dealing mainly (but not exclusively) with the environment, the focus of the ESDI Initiative was the **long-term sustainability of Canada's development**. In effect, it has been an **effort to improve and popularize the information available to Canadians to assess intergenerational equity**.

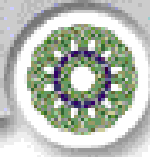


Chapter Three
THE CAPITAL MODEL





The Capital Model



The NRTEE's recommendations, especially those regarding the System of National Accounts, are based on a capital framework. The overall goal of this approach is to track stocks of the various types of capital that are used to support development at present and that will provide options for development choices in the future.

For the purposes of this approach, capital is considered to comprise Canada's national base of assets that enable us to create the set of economic and social outcomes that support continued development. These assets include **produced capital**, which consists of machinery, buildings, transportation networks, etc.; **natural capital**, which provides us with space to live, raw materials to utilize, and a clean environment within which to function; **human capital**, which enables us to make the most of our knowledge and abilities; and **social capital**, which facilitates the countless human interactions necessary for a healthy society. To maintain options for future generations to develop as they see fit, we need to maintain access to these assets over time.

Apart from the maintenance of healthy ecosystems as a goal in itself, an important objective of sustainable development is to ensure that today's economic activity does not prevent future generations from creating their own healthy economy and pursuing their own choices for quality of life. This focus on capital preservation does not imply a static economy. The elements of what constitutes a good life

change constantly. One objective of sustainability, therefore, is to allow the current generation to pursue its vision of a good life, while ensuring that other generations have equal or greater means and options—adequate capital—to pursue their own goals.

This model requires a broad view of capital that includes elements not traded in the marketplace. The model proposed by the NRTEE identifies four types of capital—produced, natural, human and social—as noted above.

The Four Types of Capital

- *Produced Capital:* produced goods that provide benefits to their owners over time, by helping to produce other goods and services. Produced capital includes equipment, buildings, machinery and other infrastructure.
- *Natural Capital:* the costed and uncoded environmental stocks and systems that provide us with the many natural materials and services upon which we rely to sustain economic activity, including natural resources, land and ecosystems. Many commentators, including those involved in the ESDI Initiative, consider environmental assets to be essential to our survival.
- *Human Capital:* the “knowledge, skills, competencies and other attributes embodied in individuals that facilitate the creation of personal, social and economic well-being.”¹ This definition of human capital extends beyond those capital assets linked directly to productivity to encompass factors that reflect the broader values associated with a healthy, well-educated population.

- *Social Capital*: the least understood of the types of capital included in the ESDI framework, social capital can be defined roughly as “the relationships, networks and norms that facilitate collective action,” including both formal and informal institutional arrangements.”² It includes “social cohesion” and is a significant feature of many quality-of-life measurements.

This emphasis on capital shifts the focus from traditional measures of current economic activity, such as the GDP, to trends in the use of, and investment in, the stocks of the different forms of capital that underpin development. Indicators and accounts developed according to this capital model should thus be able to help us in two important respects:

- obtaining a sense of the overall state of, and trends in, the capital stocks on which the economy depends for current and future performance; and
- understanding the linkages between various types of capital stocks. Are we increasing one type of capital at the expense of another? And will this affect the long-term sustainability of the economy?

Like any other approach or framework for indicators, the capital model does have limitations. From a practical point of view, there are limits to our current ability to measure and report on all dimensions of each type of capital. Equally important, the capital model still presents only a partial picture of how we as a society are faring. Indeed, several participants in the ESDI Initiative believe the full picture will need to be painted. Some of the missing aspects relate to intangible concepts that are hard to present as national indicators within this context (personal satisfaction, social connectedness, etc.). Another important limitation of the capital model, as it is applied here on a national basis, is that it does not directly account for the impact of Canadian consumption on the rest of the world’s natural capital (see section 6.3 for further discussion of this issue).

Despite these limitations, the capital model is emerging as a practical and robust basis for indicators of sustainable development, one with the ability to link current economic activity to long-term considerations. Recent initiatives such as the “wealth of nations” work by the World Bank, the work of the U.S. Interagency Working Group on Sustainable Development Indicators and the work on “genuine progress indicators” in Canada (by the Pembina Institute for Appropriate Development and GPI Atlantic) all use, to some extent, a capital-based approach. The NRTEE strongly endorses the capital model as the appropriate basis on which to expand the System of National Accounts and develop new indicators so as to provide more complete information about the impact of current choices on future opportunities.

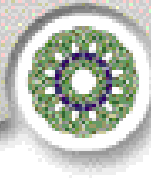
Chapter Four

**NATIONAL INDICATORS OF NATURAL
AND HUMAN CAPITAL**





National Indicators of Natural and Human Capital



The NRTEE recommends that, in addition to the GDP and other popular economic indicators, the Government of Canada should report annually a small set of indicators illustrating key aspects of natural, human—and, eventually, social—capital. To start with, this set should include the following indicators:

- Natural capital:
 - Air Quality Trend Indicator
 - Freshwater Quality Indicator
 - Greenhouse Gas Emissions Indicator
 - Forest Cover Indicator
 - Extent of Wetlands Indicator, and
- Human capital: Educational Attainment.

Each of these indicators illustrates an aspect of natural or human capital, but is by no means representative of the entire state of that form of capital. These indicators also represent but a sampling of the types of capital that are important to future generations.

Supplementing common indicators such as the GDP and the unemployment rate with this set of new indicators will, however, highlight the long-term implications of current economic activity. Like macroeconomic indicators, the recommended indicators illustrate selected issues, but do not summarize the entire state of Canada's national capital assets. All of these indicators were tested with a range of potential audiences, all of which considered them relevant and easy to understand.

In addition to providing information on representative aspects of the state of natural and human capital in Canada, these indicators will have other benefits. For example, their production will support the creation of nationwide databases on important environmental areas (e.g. water quality). It is also anticipated that these indicators will be useful to other indicator initiatives that currently address aspects of national performance or well-being. The federal Treasury Board, for instance, might use the indicators in its annual performance report to supplement the existing environmental indicators employed in this report.

Of the six selected indicators, only one is unavailable for reporting at the national level. For several others, there is a two-stage recommendation: reporting of an initial indicator for which data and analysis are currently available, followed by use of a more robust indicator in the next few years if the necessary resources are made available.

The following section provides an overview of each of the indicators recommended by the NRTEE.

4.1 NATURAL CAPITAL

Natural capital can be divided into three categories: natural resources, land and ecosystems. All are essential to preserving economic options for future generations. Natural resources provide the raw materials used in the production of manufactured goods and in the provision of many services. Economic activity occurs on land. And ecosystems provide

numerous essential services, including the cleansing of fouled air and water and the provision of productive soil, wildlife habitat and a predictable and relatively stable climate.

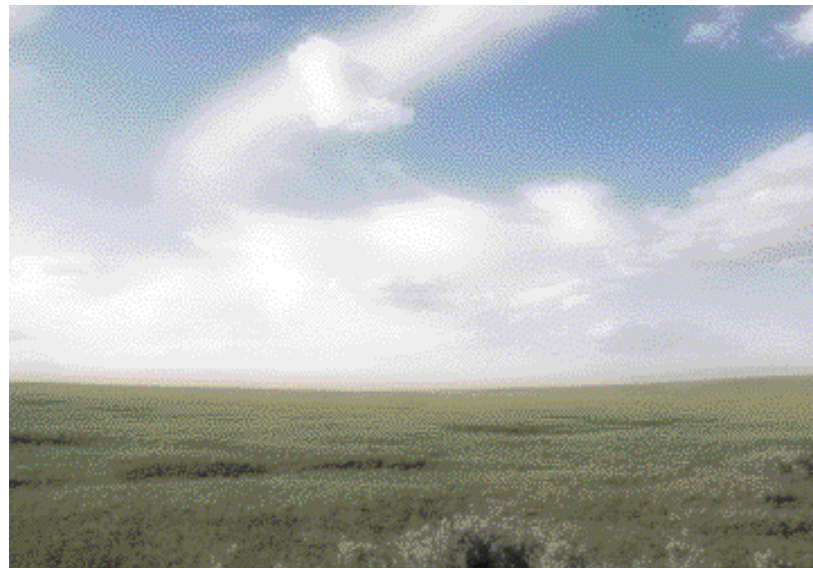
Like produced capital, natural capital is subject to deterioration from, for example, natural resource extraction, modification of land areas, or excessive waste loadings. Unlike produced capital, however, the deterioration of many types of natural capital can be avoided through environmentally sustainable practices. Indicators can help provide warning signals if human activities are disrupting ecosystem functioning to the point where the services provided by ecosystems are declining, or if these activities are changing land use patterns so significantly as to preclude future development options.

The NRTEE recommends the regular reporting of the following five indicators, as noted above:

- Air Quality Trend Indicator: a population-weighted measure of exposure to ground-level ozone;
- Freshwater Quality Indicator: a national sample of the state of water quality;
- Greenhouse Gas Emissions Indicator: the national total of annual emissions of greenhouse gases;
- Forest Cover Indicator: the percentage of Canada's total ground area that is covered by forests; and
- Extent of Wetlands Indicator: the percentage of Canada's total ground area that is covered by wetlands.

These indicators are all linked to different types of environmental capital assets that provide important ecosystem services. For instance, the air and water quality indicators point to whether we are burdening our ecosystems with pollutants, while the forest and wetland indicators track the extent of key types of ecosystems.

As is emphasized throughout this report, these indicators do not represent a comprehensive list of important natural capital indicators. The small number of indicators recommended reflects the NRTEE's mandate to identify a manageable number of illustrative, easy-to-understand indicators of importance to most Canadians. It must be noted that determining national indicators for each specific type of natural capital poses conceptual challenges. For example, developing relevant capital indicators related to ecosystem services is problematic. It is difficult to observe ecosystem processes and to value ecosystem services. Furthermore, it is impossible to quantify the "stock" of environmental assets. In many cases, we can only observe outcomes (e.g. air and water quality).



These challenges, as well as the limited quantity and quality of data with respect to many aspects of natural capital, restrict the number of natural capital indicators that can at present be reported at the national level. Additional indicators of natural capital will emerge over time. The NRTEE recognizes in particular the importance of developing a national indicator of biodiversity, and it supports the ongoing work of the Federal–Provincial–Territorial Working Group on Biodiversity to develop a Canadian Biodiversity Index. The initial development of the index framework is currently underway and expected to be completed by March 31, 2003.

The following section describes each recommended indicator. Where possible, the indicators have been calculated in the subsection entitled “The Indicator Today,” although several are still in a preliminary form. The interpretation of these indicators is preliminary as well.

In keeping with this report’s “State of the Debate” format, the indicator descriptions also outline any important areas where consensus could not be reached within the ESDI Steering Committee.

4.2 NATURAL CAPITAL 1: AIR QUALITY TREND INDICATOR

4.2.1 Description of the Proposed Indicator

Poor air quality is clearly linked to a variety of health problems, including aggravation of asthma attacks, increased severity of bronchitis and emphysema, and decreased lung function.

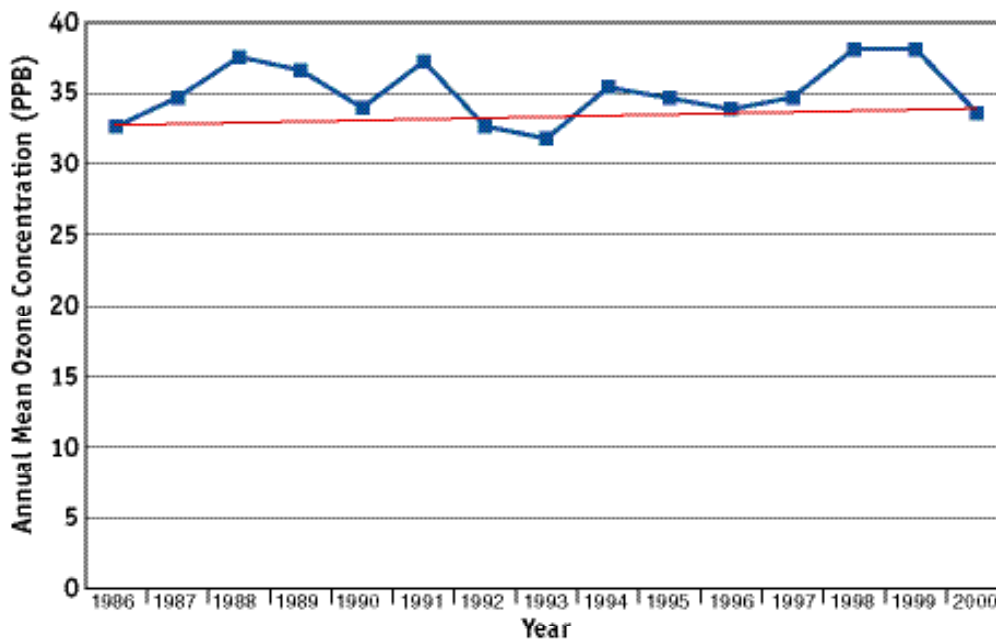
The national Air Quality Trend Indicator will provide an indication of the exposure of Canadians to a particularly harmful type of air

pollutant—ground-level ozone (O₃). This indicator is a **population-weighted measure of exposure to ozone**. It is the first readily available Canadian measure of air quality that weights exposure to a pollutant by population. In other words, this indicator tries to factor in the number of people who are exposed to low-level ozone, as well as the ambient concentrations of ozone in different parts of the country.

4.2.2 The Indicator Today

The Air Quality Trend Indicator measures the average daily eight-hour maximum ozone exposure for the population covered by selected National Air Pollution Surveillance stations; it then weights these amounts by the population living in these areas as based on census figures. Chart 1 shows the indicator for 1986 to 2000. It is based on those stations that functioned throughout this entire time period, and is measured for the April to September period (when ozone levels become problematic).

Chart 1 – Air Quality Trend Indicator, 1986 to 2000



Blue line: Air Quality Trend Indicator

Red line: Best-fit approximation of the indicator

Source: Calculated for the NRTEE by Statistics Canada and Environment Canada.

The chart shows that the Air Quality Trend Indicator increased slightly between 1986 and 2000. In plain terms, this suggests that air quality (as measured by this indicator) has not improved over this time period. Although several factors can influence this indicator (weather being perhaps the most significant), it still suggests that our efforts to reduce pollution have not yet eased the burden of ozone exposure experienced by most Canadians.

4.2.3 Rationale

The proposed Air Quality Trend Indicator is a measure of an important service provided by natural capital: the provision of air that is clean and does not negatively affect human health.

Ground-level ozone was chosen for this indicator for two reasons: the availability of reliable data linking human health effects to specific ambient concentrations of low-level ozone, and the existence of an extensive ambient concentration time series. However, the fact that other types of pollutants are not included in this version of the indicator should not be interpreted to mean that they are not associated with potential health impacts. In particular, fine particulate matter (PM_{2.5}) is a pollutant of increasing concern.

Air quality is one area where a national database is already in place. The National Air Pollution Surveillance (NAPS) network is a joint program of the federal, provincial and municipal governments to monitor and assess the quality of ambient air in Canadian urban centres. In 2000, there were 271 stations in 163 cities distributed across the provinces and territories. The interjurisdictional and cooperative nature of the NAPS program contributes to a uniform database by standardizing instrumentation, instrument operation, calibration materials, sampling probe and station siting criteria, and quality assurance programs.

The proposed indicator provides a different type of air quality information than is already readily available to the public through existing air quality indices. These various indices, versions of which are calculated by many jurisdictions, including the federal and many provincial governments, often measure the concentrations of multiple pollutants and compare them against set air quality guidelines. All try to express the severity of exposure through a single, easily understood value. The reported value of many of these indices is not an aggregation of several pollutants; it is generally based on only the pollutant with the highest measured concentration.

While indices of this nature are excellent tools for informing individuals about the relationship between the “worst” pollutant and its air quality target on any given day, the focus on only the highest measured pollutant ensures that these values are not well suited to the analysis of long-term air pollution trends. Furthermore, air quality standards vary from one jurisdiction to another, making aggregation of these indices across jurisdictions difficult.

With respect to several pollutants, including ozone, knowledge of the relationship between air quality and health has increased since the scales and guidelines for the various air quality indices were established. The fact that existing national health-based guidelines are relatively outdated was a further argument against incorporating such guidelines into the current Air Quality Trend Indicator.

For all these reasons, the ESDI Steering Committee decided to forgo the use of existing health-based air quality guidelines in the development of this indicator, even though some members felt strongly that the use of such directives could potentially assist Canadians in correctly interpreting the indicator.

4.2.4 Producing the Indicator and Future Improvements

The following agencies will be involved in producing and/or publishing this indicator:

- Statistics Canada will publish the Air Quality Trend Indicator as part of its regular reporting of all the ESDI Initiative indicators;
- Statistics Canada will determine the population weighting;
- Environment Canada's NAPS network is already producing the air quality monitoring data needed for this indicator; and
- CISE has funded a project that will improve the timeliness with which data are submitted to NAPS, thereby enabling more frequent updating of the Air Quality Trend Indicator.



During the early stages of developing this indicator, the ESDI Steering Committee considered including both ozone and fine particulate matter (PM_{2.5}) data, since fine particulate matter is also well correlated with health impacts. However, the current indicator has been restricted to ozone due, in part, to the limited nature of the PM_{2.5} data. This situation is changing, however, for the monitoring network for PM_{2.5} is steadily improving and will soon provide a robust time series.

Aggregation difficulties also led to the conclusion that focusing on only one type of pollutant is preferable for the time being. Simply combining the concentrations of the two

pollutants into one indicator would create undesirable masking effects. Take, for example, a situation where the ambient concentration of one pollutant goes down while the other goes up by the same amount—the overall indicator would stay the same. The accepted approach, therefore, is to compare the ambient concentrations of each pollutant with acceptable health-based guidelines to derive the aggregated indicator. At present, however, there are no credible, up-to-date health-based guidelines for ozone or PM_{2.5}.

Environment Canada and Health Canada are currently working on an improved health risk-based air quality index. It is hoped that this process will inform the methodology for a trend indicator based on more than one pollutant. This process will eventually lead, too, to an indicator that directly links potential health impacts to exposure to pollution. The NRTEE is proposing that Health Canada and Environment Canada continue work on this new air quality index.

4.3 NATURAL CAPITAL 2: FRESHWATER QUALITY INDICATOR

4.3.1 Description of the Proposed Indicator

Clean water is a crucial ecosystem service that supports natural habitats as well as many economic activities. Agriculture, tourism and industrial activities, for instance, are all affected by the levels of pollution found in lakes, rivers and other water bodies.

The Freshwater Quality Indicator will provide a **national measure of the overall state of water quality as measured against objectives related to major water uses in Canada** (such as water for aquatic life, recreation and agriculture). The indicator will show whether water quality is impaired to the extent that water quality objectives are not being met for these beneficial water uses (i.e. uses that do not harm water quality). As one of the most comprehensive national indicators of water quality, it will aggregate for the first time

data from existing provincial water quality indices, and will show the proportion of monitored water bodies that are classified as “marginal” or “poor.”¹ This indicator is based on the Canadian Council of Ministers of the Environment (CCME)’s water quality index.

4.3.2 The Indicator Today

A number of Canadian jurisdictions are already calculating water quality indices based on existing networks of monitored water bodies. Water quality indices based on CCME methodology are currently calculated for water bodies in Alberta, British Columbia, Manitoba, New Brunswick, Newfoundland and Labrador, Northwest Territories (for the Mackenzie River), Ontario, Nova Scotia and Prince Edward Island. Although it does not use the CCME methodology, a similar type of water quality data is collected in Quebec.

The national Freshwater Quality Indicator as calculated in this report includes data from all of these existing water quality indices and monitoring initiatives (see Table 1).² No water bodies from the Yukon or Nunavut figure in this version of the indicator, since suitable data were unavailable at the time of writing. Of all the monitored bodies of water, 21 percent are considered to exhibit marginal or poor water quality. This figure is the value of the indicator for 2002 to 2003.

Table 1 – Data for the Freshwater Quality Indicator by Water Quality Category, 2002 to 2003

Quality	No. of water quality sampling stations
Excellent	57
Good	104
Fair	90
Marginal	38
Poor	30
Total	319

Source: Calculated for the NRTEE by Environment Canada and the CCME Water Quality Task Group.

It is important to note that the Freshwater Quality Indicator calculated here is preliminary and should not be regarded as a benchmark or as a starting point for calculating trends in the future. Rather, this index is a pilot study figure that provides a first approximation for a national picture of ambient freshwater quality in Canada.

4.3.3 Rationale

The proposed Freshwater Quality Indicator is a measure of an important service provided by natural capital: the provision of water that is clean and does not negatively affect human health and ecosystems. This indicator will provide one of the only national perspectives on the overall quality of untreated fresh water in Canada.

The messages conveyed by the indicator will be straightforward: to what degree is water quality threatened or impaired, and how close is the water quality to being acceptable (i.e. in a condition that will sustain beneficial water uses)? This indicator could identify the need for a policy response or for improved prevention, mitigation or remediation efforts to ensure long-term protection and sustainable water use.

Freshwater ecosystems deliver essential goods and services to all Canadians: we utilize water for drinking, irrigation, livestock watering, industrial processing, recreational purposes, waste disposal and energy production. We depend on water to sustain aquatic organisms. Indeed, good water quality is important to sustain most forms of life.

However, water quality and freshwater ecosystems are continuously under threat from a wide variety of human activity, such as municipal wastewater discharges (sewage, combined sewer overflows and stormwater runoff), industrial effluent, waste from intensive livestock operations, agricultural runoff and the deposition of atmospheric pollution.

The methodology for the Freshwater Quality Indicator was developed and adopted by the Canadian Council of Ministers of the Environment. The CCME's goal was to create a water quality index that would track the extent to which measured concentrations of various water pollutants differ from site specific water quality objectives. These objectives are set on a case-by-case basis, according to the beneficial water uses of the water body being tested and the pollutant of concern.

Although the water quality objectives for different water bodies may vary, it is the common methodology that enables the various data to be aggregated on a national basis. Each individual jurisdiction's water quality index accounts for three aspects of non-attainment of water quality objectives:

- scope (the number of substances for which there was non-attainment);
- frequency (the number of non-attainment incidents over the measurement period); and
- amplitude (the degree by which a given water quality objective was not met).

This indicator will provide a valuable perspective on the quality of fresh water in Canada, yet its calculation also highlights the state of national data on this topic. While most jurisdictions in Canada have some capacity in water quality monitoring, data from these distributed sources have not been linked into one cohesive and consistent national information system. This situation stands in stark contrast to the data collection situation for air quality.

4.3.4 Producing the Indicator and Future Improvements

The following agencies will be involved in producing and/or publishing this indicator:

- Statistics Canada will publish the Freshwater Quality Indicator as part of its regular reporting of all of the ESDI Initiative indicators;

- Environment Canada, Statistics Canada, the CCME Water Quality Task Group and other involved jurisdictions will work together to calculate and investigate the improvement of the methodology for national aggregation;
- Environment Canada and participating jurisdictions, through their participation in the CCME, will provide the water quality information; and
- The Canadian Information System for the Environment (CISE) has funded a project to develop a national water quality data referencing system to integrate federal, provincial and municipal databases pertaining to source and drinking water quality. CISE also has an important ongoing role in the development of a more cohesive and comprehensive national water quality information system.

Over time, improvement of the indicator will depend directly on strengthened monitoring systems and better linking of networks both within and among jurisdictions across Canada. At present, the extent of the network of monitored bodies of water varies greatly from jurisdiction to jurisdiction. Also, the water bodies included in the calculation of the Freshwater Quality indicator do not currently allow for uniform coverage across Canada; rather, they tend to be concentrated in the more populated areas of the country where the potential threats to water quality are generally greatest.

In the long term, development of the indicator will move toward coverage of more substances, other media such as sediments and biota, and groundwater. Finally, the national aggregation methodology is a new one. Further work on a better aggregation methodology is necessary, as are other efforts to obtain national consistency (e.g. in the frequency and types of sampling methods and in the data reporting and assessment).

4.4 NATURAL CAPITAL 3: GREENHOUSE GAS EMISSIONS INDICATOR

4.4.1 Description of the Proposed Indicator

The national Greenhouse Gas (GHG) Emissions Indicator will be based on Environment Canada's existing greenhouse gas inventory. This indicator will track Canada's total annual emissions of greenhouse gases, excluding those substances controlled by the Montreal Protocol.³ Tracked substances therefore include carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF₆). The indicator will report aggregate emissions of all these gases in megatonnes of carbon dioxide equivalent emissions.⁴

4.4.2 The Indicator Today

The indicator will measure Canada's contribution to anthropogenic emissions of

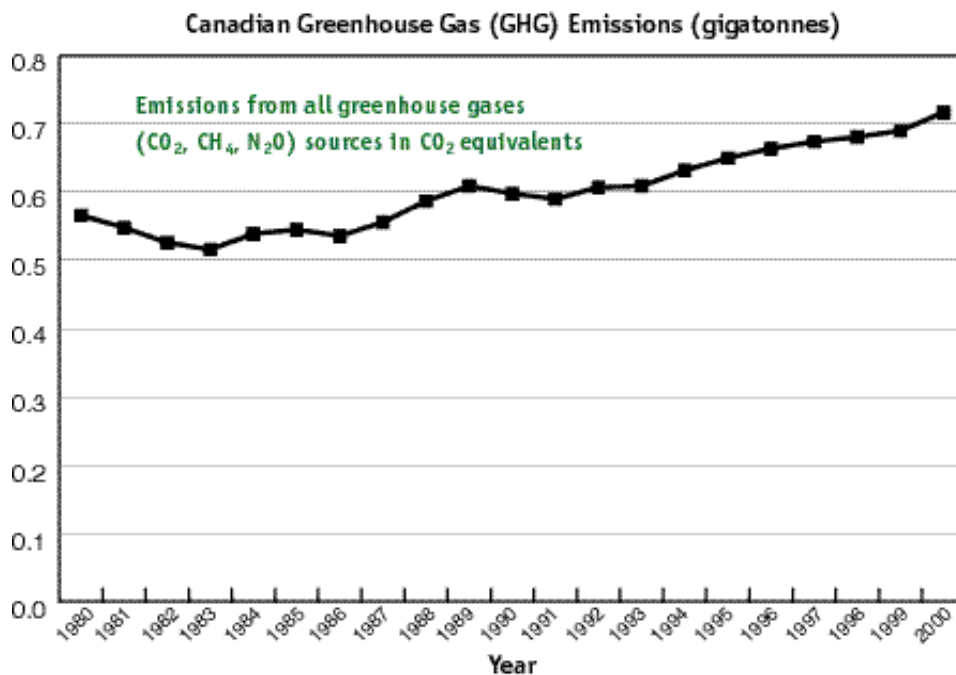
greenhouse gases (see Chart 2). Since the 1800s, concentrations of greenhouse gases in the atmosphere have risen substantially, owing to increased emissions caused by human activity. For example, the concentration of carbon dioxide has risen 30 percent since pre-industrial times, with half of that increase occurring in just the last 30 years. This has contributed to the "enhanced greenhouse effect."

Canada's Greenhouse Gas Inventory⁵ notes that Canadians contributed about 726 megatonnes of CO₂ equivalent of greenhouse gases into the atmosphere in 2000, which represents about 2 percent of total global greenhouse gas emissions in that year. Approximately 81 percent of total greenhouse gas emissions in 2000 resulted from the energy sector.

4.4.3 Rationale

Perhaps one of the most important types of ecosystem service is the provision of a stable climate. While an indicator directly measuring the impacts of climate change would be ideal,

Chart 2 – Greenhouse Gas Emissions Indicator, 1980 to 2000



Emissions from all greenhouse gases (CO₂, CH₄, N₂O) sources in CO₂ equivalents

Source: Greenhouse Gas Division, Environment Canada; U.S. Carbon Dioxide Information Analysis Center. Adapted by the National Indicators and Reporting Office, Environment Canada.

the complex nature of this topic makes the development of a credible indicator impossible for the time being. Therefore, the proposed Greenhouse Gas Emissions Indicator provides a more indirect measure of our natural capital, by measuring the demand being placed on natural capital (in this case the atmosphere) to accept greenhouse gases.

All of the gases tracked in this indicator are linked to global climate change. A group of international experts, the Intergovernmental Panel on Climate Change (IPCC), has concluded that if carbon dioxide emission rates were maintained at today's levels, atmospheric concentrations would reach almost twice the pre-industrial level of 280 parts per million by the end of the 21st century.⁶

As a country in the higher northern latitudes, Canada probably experiences greater temperature changes than do most regions of the world. A recent review of potential impacts on Canada shows that such changes would have wide-ranging implications for its economic systems, social well-being including human health, and ecological systems. Also, assuming that the world's economy will become increasingly "carbon constrained," Canada's allotment of emissions should be carefully tracked.

The 1992 United Nations Framework Convention on Climate Change (UNFCCC) requires Annex I Parties (i.e. developed countries and countries whose economies are undergoing transition to a market economy) to take actions aimed at returning net emissions of carbon dioxide and other greenhouse gases to 1990 levels by the year 2000. In 1997, the Third Conference of the Parties to the UNFCCC established the Kyoto Protocol, which sets out emission reduction targets beyond the year 2000 for Annex I Parties. The Kyoto Protocol, ratified by Canada in December 2002, requires that by the end of 2012, Canada's annual greenhouse gas emissions for the previous five years must, on average, be 6 percent lower than 1990 levels. Japan faces the same reduction target, while

emission cuts in the United States and the European Union are supposed to be 7 percent and 8 percent below 1990 levels, respectively. The United States has decided not to ratify or comply with the Kyoto Protocol at this stage.

4.4.4 Producing the Indicator and Future Improvements

The following agencies will be involved in producing and/or publishing this indicator:

- Statistics Canada will publish the indicator as part of its regular reporting of all the ESDI Initiative indicators; and
- Environment Canada will produce the data. This indicator is already calculated as part of Environment Canada's National GHG Inventory report, which is submitted to the IPCC each year as part of Canada's international reporting responsibilities.



Not all members of the ESDI Steering Committee supported this version of the indicator. Some, for example, supported energy use per capita. Such an indicator would relate to several important issues; but it would fluctuate, in part depending on the capacity of the economy, and might, therefore, be difficult to interpret. Other members supported an emissions intensity indicator (i.e. emissions divided by GDP).

Although these suggestions are not incorporated in this indicator, many of these aspects are included in indicators currently published by Environment Canada as part of Canada's Greenhouse Gas Inventory report.

Finally, some members of the NRTEE questioned the selection of an indicator that aggregates all greenhouse gas emissions. They also noted that this indicator is not a net total of greenhouse gas emissions since it does not include a complete assessment of the effects of various carbon sinks.⁷ Although work is underway to calculate the carbon sink effect of various ecosystems and human processes, high levels of uncertainty are associated with many of these figures.

This is why only some sink estimates (such as those linked to agricultural soils) are currently included in this indicator.

4.5 NATURAL CAPITAL 4: FOREST COVER INDICATOR

4.5.1 Description of the Proposed Indicator

While forested lands are sometimes viewed mainly as areas of wood production, forests also provide wildlife habitat, recreational opportunities, and ecosystem services such as mechanisms to clean air and water and sequester carbon. Measuring the area of forested land in Canada on a regular basis provides an indicator of the availability of these important ecosystem goods and services.

The goal of this indicator is to **track changes in the extent of Canada's forests**. Combining satellite remote sensing data and ground measurements, this new indicator measures changes in the area of land with a crown closure greater than 10 percent, a well-accepted threshold that the United Nations Food and Agriculture Organization defines as constituting forest.⁸ Crown closure is the percentage of the ground surface that would be covered by a downward vertical projection of the foliage in the crowns of trees. Crown closure is 100 percent when the forest crown covers all of the ground. Crown closure can be reduced by deforestation or human or natural disturbances. Similarly, it will increase as a result of afforestation or regrowth.

Canada's forests represent one of its most valuable natural resource assets. Although a measure of forest cover is not the same thing as a measure of forest health or its provision of ecosystem services, it does provide an indication of the overall extent of forest ecosystems in Canada.

4.5.2 The Indicator Today

Changes in forest cover can be analyzed over time using satellite imagery. This is a challenging process, requiring extensive calibration and validation. Currently, sufficient data to assess the extent of Canada's forest cover (i.e. the area with greater than 10-percent crown closure) are available for only one year (1998). The map in Figure 1 shows the forest crown closure for each

square kilometre (100 hectares) of Canada's landmass, as based on satellite images taken in that year. The Forest Cover Indicator will be most useful when it is calculated over a period of a few years, thereby revealing the trend in the area covered by forest.

Canada's forests have been divided into 12 ecozones, each one delineated on the basis of the interactions of the geological, landscape, soil, vegetation, climate, wildlife, water and human factors. Table 2 identifies the areas of forest in 1998 that have a crown closure greater than 10 percent within each of these ecozones. The Forest Cover Indicator is the total of these areas—or 392 million hectares in 1998. These 392 million hectares do not include sparse and patchy forest stands outside the traditional

Figure 1 – Forest Cover Map, 1998



Source: Developed for the NRTEE by Statistics Canada and Natural Resources Canada.

northern forest boundary, which may have crown closure of more than 10 percent. From the viewpoint of the impact on climate change and sustainable northern development, detecting and reporting these northern forest stands will be important, although much research is needed before accurate estimates can be obtained.

Table 2 – Breakdown of the Forest Cover Indicator by Ecozone, 1998

Ecozone	Area (million ha)
Taiga Plains	32
Taiga Shield	37
Boreal Shield	145
Atlantic Maritime	18
Mixed Wood Plains	3
Boreal Plains	49
Prairies	1
Taiga Cordillera	5
Boreal Cordillera	27
Pacific Maritime	13
Montane Cordillera	38
Hudson Plains	24
Total	392

Source: Calculated for the NRTEE by Statistics Canada and Natural Resources Canada.

The figure for 1998 should be considered a preliminary assessment of the extent of Canada's forests. A much more accurate indicator of the extent of forest cover will be possible once the satellite data have been verified against field data provided by the Canadian Forest Service. The NRTEE proposes that future versions of this indicator be verified in this way.

4.5.3 Rationale

In general, as total forest area declines, so does the overall supply of forest-related ecosystem services. On a global level, deforestation resulting from unsustainable logging practices and conversion of forest to other land uses is a major factor contributing to the loss of biodiversity and other forest-based resources.

In Canada, our ability to measure changes in forest cover has historically been limited by the difficulty of collecting national data over such a large area in a timely fashion. Preparation of an inventory of forest resources typically took place over a number of years, with various provincial inventories being conducted and completed at different times. Updates to these assessments were infrequent. Therefore, existing data on forests, including the current national compilation of forest inventory data, do not lend themselves to the creation of a time series.

The advent of satellite technology is changing this. The proposed Forest Cover Indicator will provide a timely measure of the extent of Canada's forests by making use of satellite images of the entire forest area taken, in effect, "all at once" and at regular intervals. It will be updated annually using satellite images from the Canada Centre for Remote Sensing and validated using field measurements of crown closure from the National Forest Inventory (NFI). The NFI and the Earth Observation for Sustainable Development of Forests (EOSD) programs will also provide a baseline for forest area with crown closure greater than 10 percent.

Because the proposed new indicator measures forest cover, it may report a different value than the current estimate of forest land in Canada, which is based on a compilation of forest inventories from various sources. An important distinction between forest cover and forest land is that the latter includes areas that have been harvested or disturbed (such as by fire), and thus may temporarily have lost their forest cover.

The new indicator of forest cover will fluctuate annually, reflecting both temporary changes, such as those due to harvesting, natural disturbance or reforestation, or more permanent changes such as deforestation, afforestation or land-use conversion.

Although a measure of forest cover is not the same thing as a measure of forest health or its provision of ecosystem services, it does provide an easy-to-understand and readily available indication of the overall extent of forest ecosystems in Canada.

4.5.4 Producing the Indicator and Future Improvements

The following agencies will be involved in producing and/or publishing this indicator:

- Statistics Canada will publish the Forest Cover Indicator as part of its regular reporting of all of the ESDI Initiative indicators;
- Natural Resources Canada–Canada Centre for Remote Sensing will collect and interpret the satellite data; and
- The new National Forest Inventory, coordinated by Natural Resources Canada–Canadian Forest Service, will provide data for verification of the satellite product.

There are no significant methodological barriers to the production of this indicator. However, as noted above, it is strongly recommended that any new versions of this indicator be improved by verification against field data. Additional resources will be necessary for the interpretation, verification and regular acquisition of the satellite data.

Over time, the indicator will be refined through the use of satellite data produced at a better resolution than is currently possible, perhaps allowing for the detection of different types of forest ecosystems and other important factors.

4.6 NATURAL CAPITAL 5: EXTENT OF WETLANDS INDICATOR

4.6.1 Description of the Proposed Indicator

Canada is the steward of a large proportion of the world's wetland areas, which represent a natural legacy of global importance. Based on satellite remote sensing data, this indicator will **measure the extent of wetlands in Canada and the change in this area over time.**

4.6.2 The Indicator Today

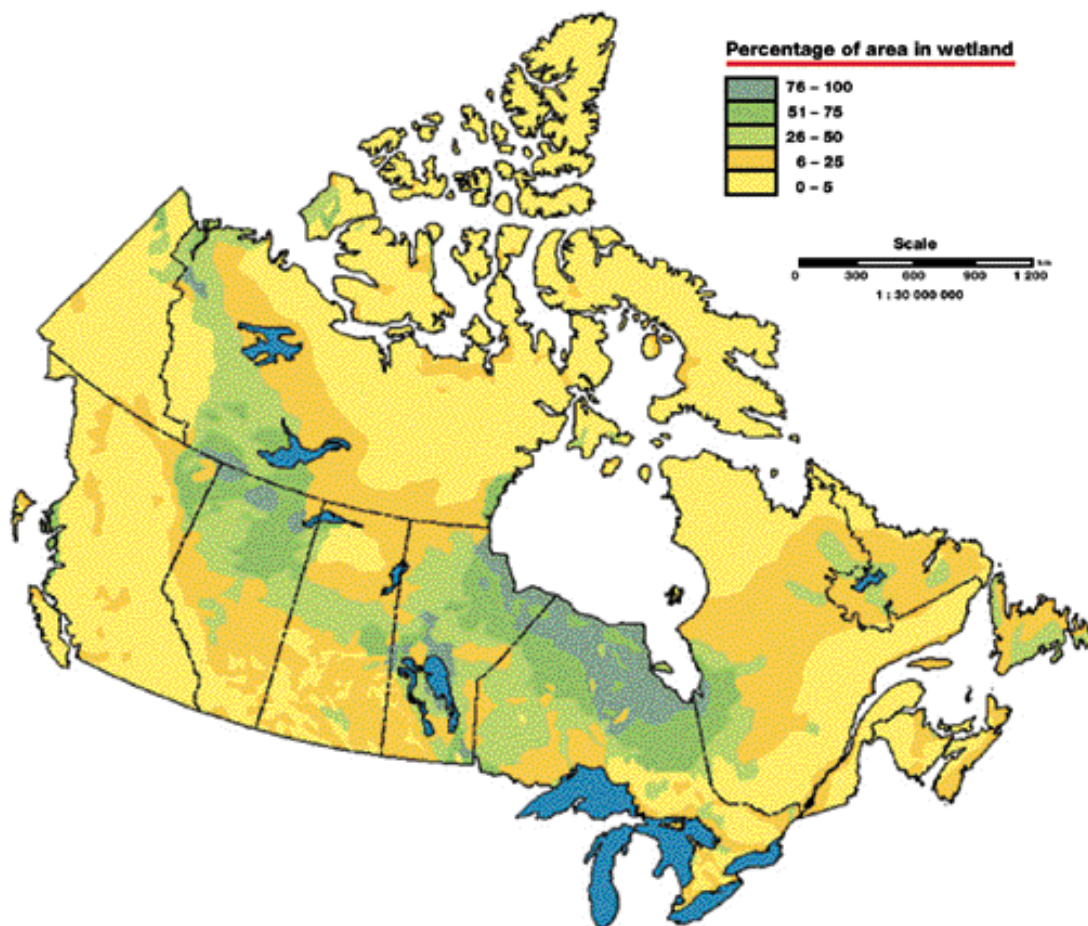
The Extent of Wetlands Indicator is the only recommended indicator for which no reasonably credible national data are available at present. Despite the absence of good data tracking the national extent of Canada's wetlands over time,

enough evidence exists to conclude that wetlands are at possible risk and that a wetlands indicator should be developed.

Figure 2 provides a rough indication of the distribution of wetlands in Canada. Unfortunately, as discussed in section 4.6.3, much of the data used to create this map has serious limitations.

Generally, wetlands are found in the central provinces and are sparsest in the eastern Arctic and in mountainous areas. For example, significant concentrations of wetlands are found in the Boreal Shield and Taiga Plains. More specifically, the highest concentrations of wetlands are found in southern portions of Hudson Bay, in areas north of Lake Winnipeg, and along the Alberta–Northwest Territory and the Yukon–Northwest Territory boundaries.

Figure 2 – Distribution of Wetlands, 1986



Source: Energy, Mines and Resources Canada, "Distribution of Wetlands," National Atlas of Canada, 5th Edition (1986). Cited in Statistics Canada, *Human Activity and the Environment 2000*, Cat. No. 11-509-XPE (2000).

A significant portion of Canada's southern wetland area has been lost due to draining or conversions to other uses. For instance, wetland conversions are estimated to have occurred in 70 percent of central prairie wetland sloughs, 65 percent of Atlantic salt marshes, 80 to 98 percent of urban wetlands, 70 percent of Pacific estuarine marshes, and 70 to 80 percent of southern Ontario and St. Lawrence Valley hardwood and shoreline swamps.⁹ However, these assessments are simply estimates and are not based on concrete data that can be used for verification purposes.

4.6.3 Rationale

Despite the lack of immediately available data on wetlands extent over time, the NRTEE decided to retain this indicator for two reasons: the existence of methodologies and satellite data sources that could create a feasible wetlands indicator in the short term, and the importance of wetland habitats.

Wetlands are a significant type of natural capital, rich in productivity and diversity. They provide habitat, food and protection to many species. In Canada, it is estimated that more than 600 game and non-game species, including one third of Canada's species at risk, are found in wetland ecosystems.¹⁰ Wetlands are also biodiversity "hotspots," and it has been suggested that the "stock" of Canada's wetlands could provide a proxy for overall ecosystem health.

Wetlands also provide many essential ecosystem services. The biological activities they support help to filter and purify water and to store large quantities of carbon. Through the retention and release of large volumes of water, they help replenish and store groundwater, control floods and storm waters, reduce erosion and protect shorelines. As well, they indirectly support a range of economic activities such as fishing, farming and recreational activities.

Concern is being expressed by many sectors in Canada, including industry, that both the extent and health of our wetlands are being eroded. However, at present, there is no national understanding of the extent to which this is actually taking place and no ongoing measurement and reporting at the national level. Despite considerable wetlands expertise in Canada, existing data cannot support a national indicator due to a lack of coverage, time series and consistent data standards.

Currently, at the national level, there are several wetland inventories of significance, including national maps estimating the location of wetlands and peatlands in Canada (see Figure 2). However, these maps are based on data collected during different time periods (e.g. in some areas, the most recent data are from the 1960s), do not permit time series analysis, and are of very low resolution. Although various regional and provincial inventories exist,¹¹ it is difficult to combine existing inventories to reflect a larger area.

If this indicator is implemented, it will be the only indicator that can provide a timely national assessment of changes to wetland area over time. As such, it will provide a valuable tool in assessing threats to this type of ecosystem, such as the impact of climate change (particularly with regard to northern wetlands) and urbanization.

4.6.4 Producing the Indicator and Future Improvements

Because of the serious limitations with existing data, it will require approximately two years of work to develop and refine satellite data suitable for reporting the Extent of Wetlands Indicator.

The following agencies will be involved in producing and/or publishing this indicator:

- Statistics Canada will publish the Extent of Wetlands Indicator as part of its regular reporting of all the ESDI Initiative indicators; and
- Natural Resources Canada—Canada Centre for Remote Sensing, the Canadian Space Agency and Environment Canada will work together to collect the satellite data and develop the indicator.

The indicator will measure the overall area covered by wetlands, but it will not distinguish between different types of wetlands. Future improvements may be possible, however, through the addition of information on wetland type to the indicator's database. The Canadian Wildlife Service (Environment Canada) in conjunction with the Canadian Space Agency is developing the methodology for a wetland inventory and classification system based on remote sensing data that would provide this type of information. Phase I of this project, which includes the creation of a coordinated and comprehensive wetland inventory in four test areas of the country¹² has shown promising results; it is funded by CISE and the Canadian Space Agency.

4.7 HUMAN CAPITAL INDICATOR: EDUCATIONAL ATTAINMENT OF THE WORKING-AGE POPULATION

As noted earlier, current accounting mechanisms treat investments in human capital (e.g. education, lifelong learning, disease prevention and health promotion) as consumption or costs rather than investments in capital development. An expanded capital accounting framework would help clarify the long-term return on human capital that can result from these types of investments.

Human capital refers to the “knowledge, skills, competencies and attributes embodied in individuals that facilitate the creation of personal, social and economic well-being.”¹³ This definition of human capital extends beyond those capital assets linked directly to productivity to encompass factors that reflect the broader values associated with a healthy, well-educated population.

The term “human capital” has traditionally been applied to educational attainment and includes the knowledge and skills that the labour force accumulates through formal instruction, training and experience. The concept of human capital can also be applied to the health of the working population (or labour force). Everything else being equal, an experienced and well-educated workforce will be more productive than one with less human capital. It will be more innovative and will work more efficiently. Similarly, a healthy workforce will be more productive than an unhealthy one.

Like produced capital, human capital is susceptible to deterioration. This is partly because workers retire and have to be replaced, but also because knowledge and experience can become obsolete as new technology is introduced. Therefore, continual investment in the factors that contribute to human capital is required if the economy is to be sustainable.

It is only in recent decades, with the study of productivity, that the notion of human capital has come to the forefront in economics. As a result, there are no official estimates of human capital in Canada at this time. Education and health statistics, on the other hand, are much more readily available.

4.7.1 Description of the Proposed Indicator

The Human Capital Indicator measures the percentage of the population between the ages of 25 and 64 that has gained upper-secondary and tertiary-level educational qualifications (see Chart 3). In other words, this indicator tracks the proportion of people who have achieved at least a university bachelor’s degree, or a diploma or certificate from educational institutions beyond the secondary level.¹⁴ This indicator also includes individuals who have earned certificates below the bachelor level from a university.

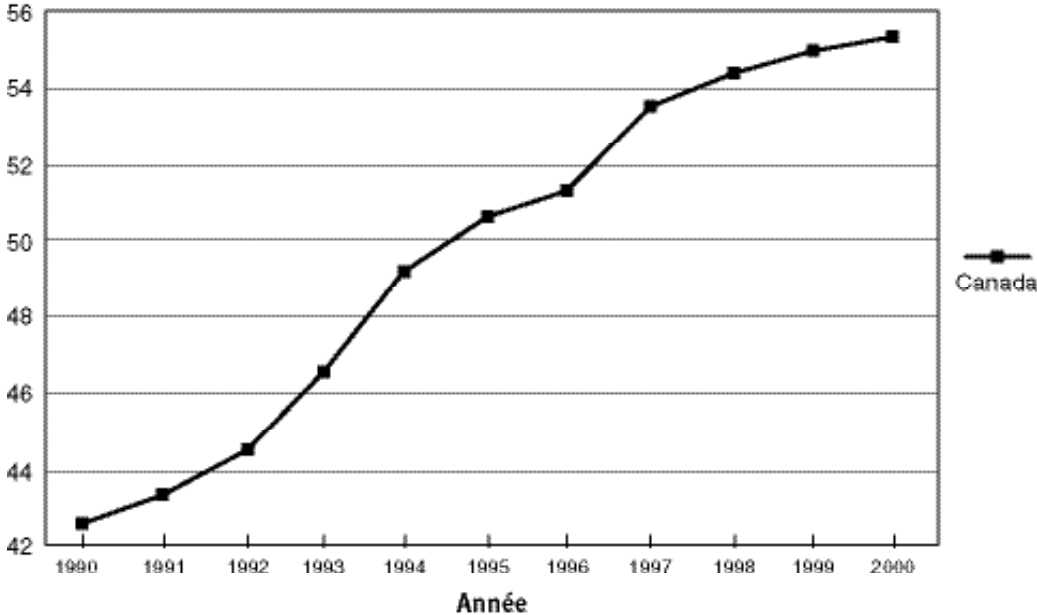
4.7.2 Rationale

Measures of educational attainment are the most commonly used proxies for human capital.¹⁵ It is also possible to link educational attainment to income-earning power, making this indicator relatively easy to monetize.

The Human Capital Indicator will be more relevant as a way to demonstrate trends over time than as an absolute measure. It could also be used to compare Canada’s educational attainment against that of other members of the Organization for Economic Co-operation and Development (OECD), providing an indication of Canada’s relative ability to “compete” in the knowledge-based economy.

The indicator is a straightforward way to describe the educational attainment of the population, because it is based on the percentage of people who successfully complete a given level of formal education.

Chart 3 – Human Capital Indicator, 1990 to 2000

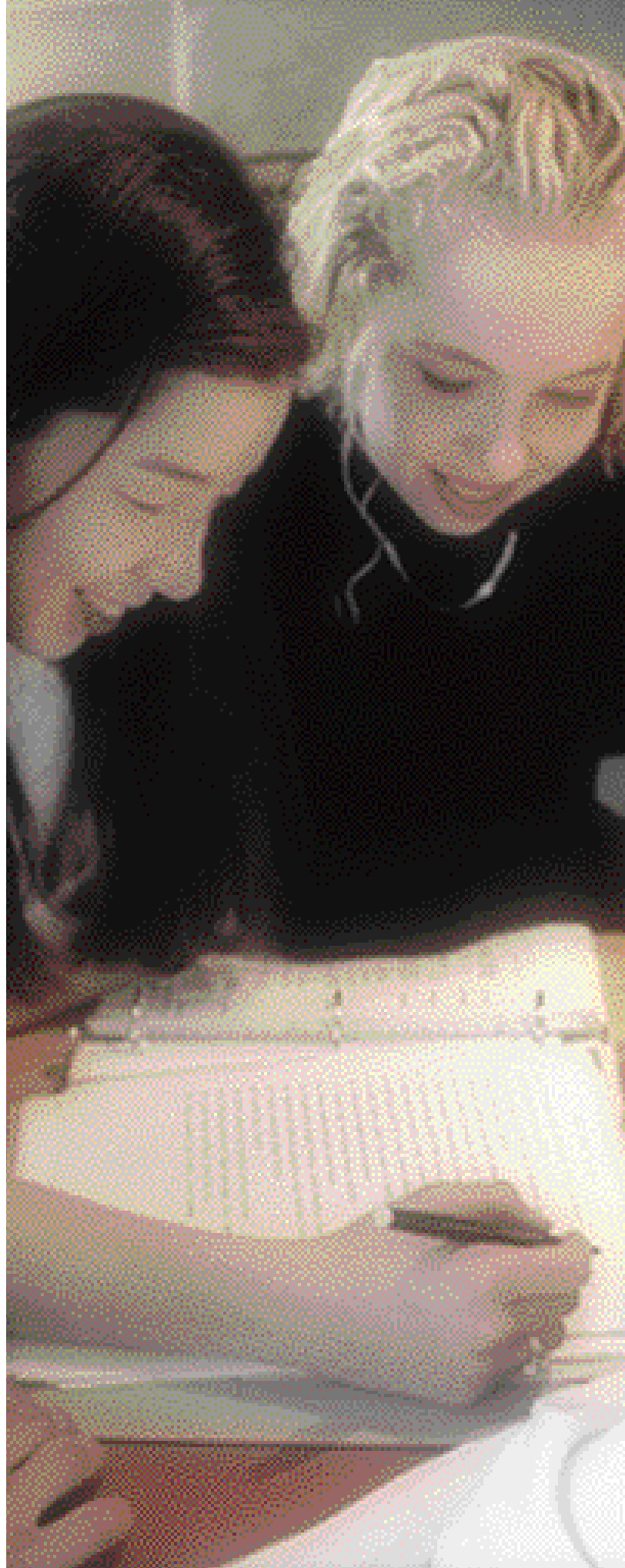


Source: Statistics Canada, Educational Indicators in Canada: *Report of the Pan-Canadian Education Indicators Program 1999*. Cat. No. 81-582-XPE, Canadian Educational Statistics Council (Ottawa, 2000)

4.7.3 Producing the Indicator and Future Improvements

Statistics Canada will produce and publish this indicator. Although useful, this measure—like other quantitative measures of human capital—does not provide information on the quality of human capital being accumulated (or lost). Measures of functional literacy and numeracy, as well as new means of measuring educational outcomes and less formal forms of training, will be needed as the human capital accounts within the SNA are further developed.

It should be noted that although this indicator received widespread support from participants in the ESDI Initiative, there were also proposals for a second indicator of human capital based on the health status of Canadians. Other participants suggested that the educational attainment indicator not be age-restricted so that it could encompass the ongoing contribution of younger and older portions of the population to the national stock of human capital.

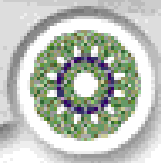


Chapter Five
A BETTER CAPITAL
INFORMATION FRAMEWORK





A Better Capital Information Framework



The development of indicators was the ESDI Initiative's primary mandate. However, it soon became clear that these indicators are only as good as the information system from which they are derived. Because of the importance of high-quality data and information, the NRTEE recommends the creation of a national information system for capital assets. This system will have two important characteristics:

- It will better link issues of economy and capital assets. By expanding the System of National Accounts (SNA) to include accounts pertaining to natural, human and social capital, this system will offer a much more robust analytical framework for incorporating long-term considerations into economic decision making.
- It will increase the amount of high-quality, consistent national environmental data. Key to the creation of new capital accounts will be the provision of more, and most likely, new information. Increased support of monitoring efforts (including remote sensing information) and CISE are crucial to the success of this proposal.

As noted above, short-term work will focus on those extensions to the national accounts that are directly linked to the proposed indicators. The following section describes the long-term vision. It provides a detailed assessment of the recommended system of capital information, which includes a description of the proposed new capital accounts within the SNA and a

discussion of the role of CISE.¹

5.1 EXPANDING THE SYSTEM OF NATIONAL ACCOUNTS

The SNA, which has evolved over the past 50 years, serves as the basis for estimating most of our important macroeconomic indicators, including the GDP and the balance of trade. As such, the SNA provides the most widely used framework for structural analysis of the Canadian economy. To supply data for the new indicators of national capital, and to provide comprehensive information about Canada's capital assets, the NRTEE recommends that the Government of Canada invest in a permanent expansion of its SNA to include explicit measures of natural, human and social capital.

The SNA already provides valuable information to support economic analysis and development decisions. However, there is a clear need to expand the scope of that type of analysis and to base development decisions on a fuller understanding of the long-term implications of current activities. Although it has evolved considerably since it was first published, the SNA continues to focus primarily on market economic activity. It includes, for example, input and output data for about 700 goods and services produced by over 300 types of industries. Currently, however, the SNA excludes data on unpriced natural resource flows into the economic system and unpriced pollutant flows from the economy into the environment. Likewise, the accounts currently include no measures of human or social capital.²

Expanding the national accounts will help create a comprehensive, coherent and consistent information system that establishes linkages between environmental, social and economic

issues. This will enable measurement of our overall base of capital assets, providing a more complete picture of Canada's total wealth and assisting in policy and decision making. For instance, this information could help clarify the implicit values that we place on such things as clean air. Canadians spend significant amounts of money to prevent, reduce or remediate air (and other) pollution. In doing so, we are attributing an implicit value to the resulting environmental quality. Developing a national information system that would enable us to identify and account for those implicit social valuations will add considerable value to the policy development process.

Similarly, accounting for such things as health promotion and education expenditures as investments in (human) capital development could have a significant impact on the way Canadians view their economic and public policy choices. It could provide a new perspective on the adequacy of such outlays in the context of an aging population, the rapid expansion of knowledge and technological achievement in the modern world, and the ongoing national debate on health-related spending. Indeed, the budget trade-offs faced by governments, businesses and households might all, with this new information, be viewed differently.

There is widespread agreement among statisticians and others around the world on the desirability of providing the types of information outlined above. With regard to environmental information, guidelines for incorporating this type of data into the systems of national accounts are included in the forthcoming United Nations manual entitled *System of Environmental and Economic Accounts 2003*.³

Work to expand the SNA will build on Statistics Canada's efforts, carried out under the Green Plan in the early and mid-1990s, to develop accounts for selected measures of natural capital (such as subsoil mineral assets). However, it will take years to achieve a comprehensive extension of the SNA that provides a robust set of data

covering each of the main types of capital. For this reason, the NRTEE recommends long-term support for Statistics Canada's activities in this area.

5.1.1 New Natural Capital Accounts

The natural capital information in the System of National Accounts should include:

- natural capital asset stock accounts,
- material and energy flow accounts, and
- environmental protection accounts.

Natural Capital Asset Stock Accounts

The amount and quality of information about natural capital varies considerably. Natural capital can be measured in various ways. The most direct measures are those of the stocks of natural capital assets. Statistics Canada has created basic, if incomplete, accounts for some natural resource stocks (timber, subsoil assets and land) and some land areas, but has very limited information on other natural resource stocks (water and marine resources) and essentially no information about the environmental assets that provide flows of ecosystem services.

Some indicators of natural capital also address trends in the depletion or degradation of natural capital. Statistics Canada and federal and provincial natural resource agencies maintain some information on natural resource consumption (i.e. depletion). However, Statistics Canada itself collects no information with respect to degradation. The successful extension of the SNA will be dependant on the creation of partnerships with those agencies that collect this type of data (e.g. Environment Canada, Natural Resources Canada and Agriculture Canada). Other government departments and agencies, academics and non-governmental organizations hold data relevant to these stocks, but these data are generally scattered, incomplete and not integrated on a national basis. Despite considerable reporting efforts at the facility level, national-level pollution data are limited and inconsistent, and other factors that affect the

state of our natural capital, such as urbanization and tourism, are either not measured or are poorly measured. Therefore, the participation of CISE and the need for increased monitoring are both of great importance.

The expanded asset accounts will measure quantities of natural capital (natural resources, land and ecosystems) and the annual changes in these stocks due to natural and human processes. These stocks will form the basis for estimates of Canada's natural resource wealth, which could be included in the overall estimate of national wealth in Canada's System of National Accounts (see section 5.1.4) to complement traditional measures of produced wealth. The result will be a more complete picture of Canada's total wealth. Balance sheet data on natural resources will also enable assessments of the degree to which produced capital is being used as a substitute for natural capital. In addition, such data could be of interest for monitoring the availability and exploitation of these resources.

Natural capital stock accounts will be closely related to material flow accounts (see page 42). The annual depletion or harvest of natural resource stocks recorded in physical units in the natural capital stock accounts will represent a portion of the resource flows recorded in the material flow accounts. Also, the integration of both accounts could be used to measure the impact of material use on the stock of "virgin" resources in the environment.

Over time, the natural capital stock accounts should be developed to include:

- Subsoil Asset Accounts: physical measures of stocks of non-renewable subsoil assets (fossil fuels, minerals and metals) along with monetary estimates of the stock value;
- Biological and Resource Asset Accounts: quantity and quality of renewable biological assets (commercial timber, marine resources, trapped and hunted wildlife), along with monetary estimates of the stock value;

- Land and Terrestrial Ecosystem Asset Accounts: the physical extent of Canada's land area classified by dominant land use, land cover and land capability. These accounts will include a "land-use change matrix" that portrays the conversion of land between land-use categories (and changes in soil quality) during specified time periods (e.g. five years). Where possible, these accounts will also include estimates of the value of Canada's land;
- Water and Aquatic Ecosystem Asset Accounts: accounts that include the amount of water renewed by watershed basin from precipitation, surface water flows, and groundwater flows; the extent and quality of Canada's important aquatic ecosystems (lakes, rivers, marshes, bogs, etc.); and a monetary value for water resources that are commercially exploited. A collaborative project between Statistics Canada and Environment Canada is currently estimating the national value of Canada's water resources and developing a monetary national water resource account that could be integrated in the proposed set of natural capital accounts.
- Atmospheric Asset Accounts: information on climate-related issues including growing degree days, extremes of climate variability, and air quality in urban centres.

Material and Energy Flow Accounts

Material flow accounts will record, in physical terms, the flows of materials both between the Canadian economy and the “rest of the world,” and between the economy and the environment. These flows should include natural resources (e.g. water, energy, minerals), recycled materials (e.g. metals, paper, wood), wastes (e.g. greenhouse gases, solid and liquid wastes) and toxic chemicals (e.g. pesticides, fertilizers). Linking these accounts directly to the economic statistics in the System of National Accounts will provide valuable information about the extent to which the economy places demands on the environment as a source of raw materials and as a sink for waste materials. Moreover, by linking physical measures with data from the input–output accounts based on the industry sector, it should be possible to produce detailed estimates of the resource and waste intensity of various types of economic activities. These intensities will measure the physical quantities of resources (or wastes) used (or produced) per unit of economic activity (a measure of eco-efficiency).

Environmental Protection Accounts

The depletion and degradation of natural capital are recognized as serious problems by society, and a good deal of activity is already devoted to combatting them. Companies spend money to install pollution-control equipment and to clean up the effects of past environmental degradation. Governments invest in treatment plants to reduce the damage done to our lakes and rivers from sewage. Households participate in recycling programs and give money to non-profit organizations with environmental goals.

Most of this activity is already measured in the national accounts, but it is not made explicit. Based on the existing accounts, we cannot say for certain whether environmental protection expenditures are going up or down, or how they are distributed across industries and levels of government. Neither can we say much about the economic growth potential offered by the production of environmental goods and services.

Companies making these products want to know whether the demand for them is increasing over time and, if so, where it is originating. Is it mainly businesses that spend money on such products? Or do governments buy a lot of them too? How much of the demand originates in foreign countries and represents an export opportunity for Canadian businesses? The environmental protection accounts will be designed to offer answers to these legitimate and important questions.

5.1.2 Human Capital Accounts

Although Statistics Canada measures many factors associated with human capital, it does not produce official estimates of human capital. The practice of labelling all human development expenditures as (current) consumption misrepresents Canada’s overall capital stocks. Saving and investment may be understated, and any analysis of the factors behind economic growth that does not account for investments in education will be incomplete. As human capital is one of the most important assets of a country, it should be included in the national accounts: human development expenditures that have a long-run qualitative and quantitative payoff should be classified as investment and appropriately accumulated into human capital stocks.

5.1.3 Social Capital Accounts

There is an emerging realization that the formal and informal institutional arrangements, relationships, networks and norms that facilitate collective action are important to a society’s ability to function effectively and to the well-being of individuals within that society. Governments trying to promote clean, safe neighbourhoods need well-functioning institutions and a legal system that is respected by citizens. As well, individuals need social networks to feel connected to their community and to have opportunities to express themselves and develop effective interpersonal relationships.

Despite its obvious importance, current understanding of “social capital” is much less advanced than for the other types of capital. Without a clear conceptual understanding of precisely what is meant by social capital, it is not possible to measure or report on it. Nonetheless, work to understand and learn how to measure social capital is accelerating throughout the world. Recent publications by the World Bank and the OECD have highlighted the extensive academic work underway in the United States and Europe in particular.⁴ In Canada, the work of Professor John Helliwell⁵ and others is generating considerable interest; as well, Statistics Canada is conducting research in the area and plans to use the 2003 cycle of the General Social Survey to collect information relevant to social capital.

Reflecting current thinking on this important topic, the NRTEE examined the linkages between human capital and social capital, and developed a capital framework that included a provision for data and indicators on social capital. However, because of the preliminary state of knowledge on this topic, the NRTEE did not develop specific indicators of social capital to recommend for short-term use. In order to achieve a system of indicators that provides information on all aspects of Canadian capital assets, it will be important to continue to support this work in the long term, with the objective of incorporating measures of social capital into the expanded System of National Accounts.

5.1.4 A National Wealth Indicator

Over time, the expanded accounts could be used to calculate an expanded estimate of Canada’s national wealth, a single measure of the nation’s wealth aggregating in one number the full range of capital assets. By increasing the range of capital accounts, this measure would eventually indicate in a theoretically robust fashion whether the nation’s capacity to support ongoing development is increasing or decreasing in terms of changes to its overall capital base.

Many countries are experimenting with some form of expanded national wealth accounting. Some of these efforts focus on “total wealth” (the total value of all capital in any given year); some focus on “genuine savings” (the annual change in value of all capital, accounting for consumption of and income from all sources of capital); and others focus on “net national product” (total consumption less total depreciation, including the depreciation of natural capital stocks). All of these initiatives are at early stages; as yet none has developed and started reporting regularly on a comprehensive aggregate indicator.⁶ The most comprehensive work is being done by the World Bank, which has produced estimates of “genuine savings” for various countries, including Canada.⁷

The development of this type of single, aggregated indicator is highly controversial. It raises difficult questions about what types of capital should be monetized, how to estimate the value of non-market assets, and whether it is appropriate to assume that all types of capital are substitutable for one another and can therefore be aggregated into a single overall value (see section 6.2).

The NRTEE recommends that Canada build on the path-breaking efforts of the World Bank and use an expanded System of National Accounts as the basis on which to work toward the regular publication of an expanded national wealth indicator. As the development of techniques for monetizing non-market assets continues, this national wealth indicator will expand to include a broader range of capital. For the time being, however, the national wealth indicator will be accompanied by additional indicators of natural and human (and, ultimately, social) capital for which monetary estimates are not currently possible or credible. These are the indicators recommended in section 4.

5.2 IMPROVING THE QUANTITY AND QUALITY OF ENVIRONMENTAL INFORMATION AVAILABLE TO CANADIANS

The System of National Accounts will provide a structured approach to relating trends in natural, human and, eventually, social capital to economic data. However, these new accounts must be populated with reliable and consistent data covering the entire country. An expansion of the SNA depends on the ability of data providers to continue with, and expand, monitoring activities, especially in regard to environmental issues.

One of the most important findings of the ESDI Initiative is the surprisingly poor quality of much of Canada's national-level environmental information, especially for a country that prides itself on the extent of its relationship with nature. Because of the lack of sufficiently comprehensive, coherent, current and authoritative data, it is not possible to report with confidence on various indicators.

Therefore, the NRTEE recommends investment in the systems needed to generate and improve national-level environmental information. In particular, the government should support implementation of the Canadian Information System for the Environment.

While the government has approved CISE in principle, it has not yet recognized that it will require significant resource allocations. Existing CISE activities are being funded from temporary reallocations from within Environment Canada's existing budget. To be effective, however, CISE needs more than ad hoc funding. Providing stable, ongoing support for CISE will greatly enhance the provision of accurate, timely information about Canada's natural capital and

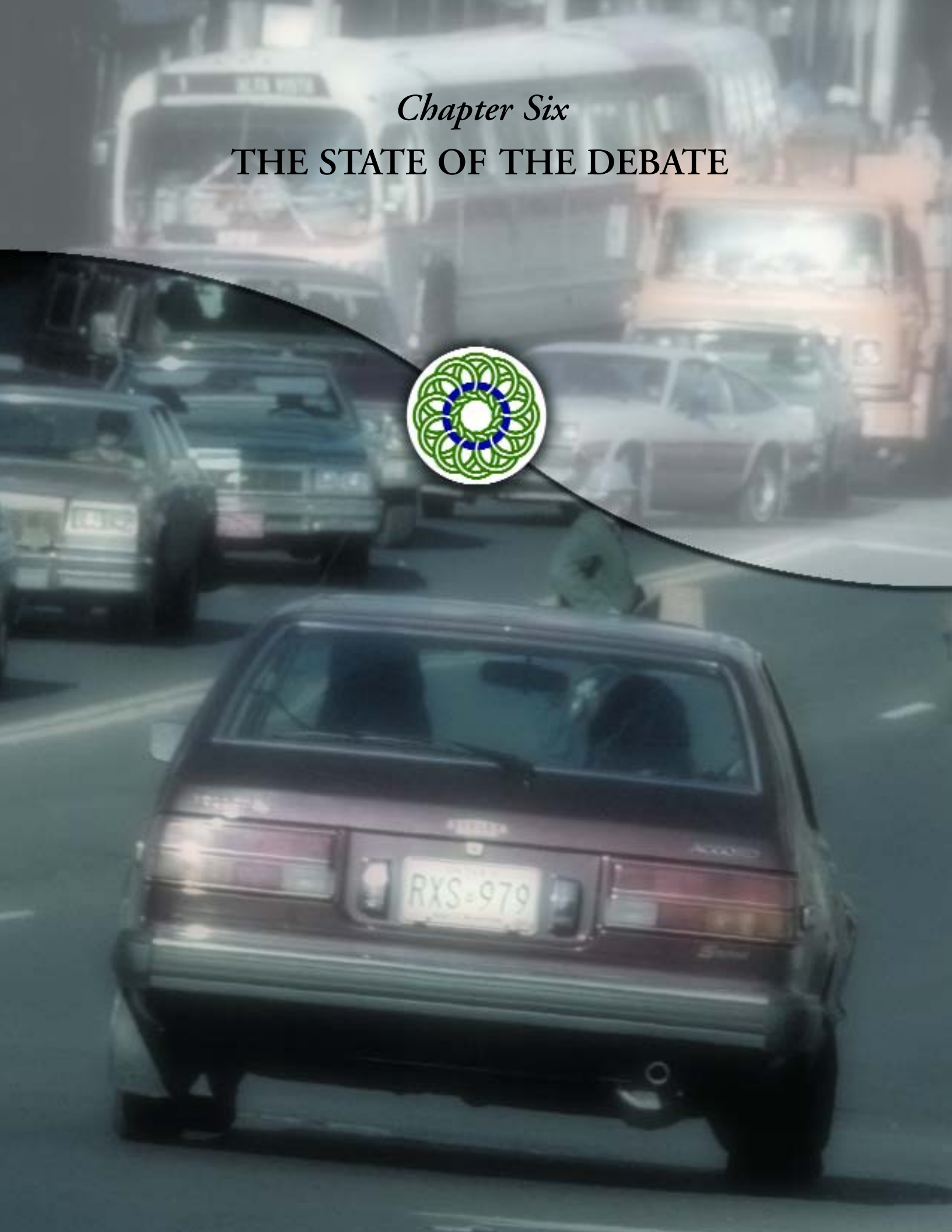
environmental conditions. It will also assist in creating detailed indicator databases that can be disaggregated by sector and geographic area to appropriate scales for use by different levels of government and various organizations.

With the limited funding currently at its disposal, CISE has already begun to address some of the data concerns related to indicators recommended in this report, including those that deal with air quality, water quality and wetlands.

The early implementation phase of CISE also includes projects that focus on developing partnerships and putting in place mechanisms and infrastructure for sharing information among various agencies and jurisdictions. Significant partnerships are being developed with the National Forest Information System and GeoConnections (both initiatives of Natural Resources Canada), the National Land and Water Information Service (part of Agriculture and Agri-Food Canada), the Canadian Space Agency, provinces, territories and non-governmental organizations.

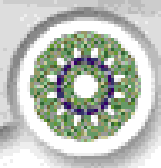
In addition to the creation of consistent and accessible databases by CISE, increased environmental monitoring of all kinds is necessary. In particular, the expanded availability of accurate, regularly updated remote sensing data holds great promise for the creation of proper national indicators for many forms of natural capital, particularly those related to land cover and quality.

Chapter Six
THE STATE OF THE DEBATE





The State of the Debate



The ESDI Initiative revealed many areas of agreement among participants. But it also pointed to some important areas of continuing debate.

6.1 SUMMARY OF AREAS OF AGREEMENT

There was general agreement on the three broad areas of recommendations elaborated in sections 4 and 5: report annually a small set of new, national-level natural and human capital indicators; expand the System of National Accounts; and improve national environmental indicators.

In particular, there was widespread support for the premise that the indicators be developed using a capital model to address intergenerational equity issues. Several participants, however, felt there should have been a greater emphasis on measurement of intragenerational equity. There was also strong support for including indicators of natural and human capital. Despite various methodological and philosophical disagreements about precisely what and how to measure, most participants agreed that the proposed indicators of air quality, water quality, greenhouse gas emissions, forest cover, extent of wetlands and educational attainment all provide important information and can conceivably be linked to economic activity.

Most participants also agreed that certain other national indicators of capital are important, but cannot be included or reported at present. For instance, a significant number of program participants voiced strong support for including social capital in the ESDI framework and for

supporting the work underway in Canada and elsewhere to develop indicators of various aspects of social capital.

Similarly, ESDI participants agreed that the issue of ecological thresholds is important but that it may require a pragmatic resolution. Various participants, particularly in some of the cluster groups, emphasized the importance of developing indicators that account for or provide information about: a) thresholds beyond which damage may be irreversible or b) thresholds related to carrying capacity. In many cases, however, the cluster groups recognized that current science is not able to identify such thresholds with any precision. Most participants agreed that the absence of a well-understood threshold should not preclude the development of an indicator. Instead, indicators should provide directional information (i.e. are things getting better or worse?).

Finally, despite some very different conceptual starting points, most participants also supported the need to adopt a pragmatic approach to indicator development, focusing on those that can be realistically be developed in the short term. Participants also emphasized the importance of interjurisdictional cooperation to avoid duplication of effort and to ensure that data are collected and reported in a consistent manner across the country.

The remainder of this section describes some of the main areas of debate that arose over the course of the ESDI Initiative.

6.2 A SINGLE, AGGREGATED INDICATOR VERSUS VARIOUS REPRESENTATIVE INDICATORS

Whether and how to aggregate information about Canada's overall capital was one of the more controversial issues to confront the ESDI Initiative participants. The prospect of a single, aggregated indicator of national sustainability is of considerable interest to a wide range of Canadians. A single, easy-to-understand number could become as important and as often used as the GDP. As well, commentators and decision makers are more likely to refer to a single number than to an array of statistics. Finally, a single number makes annual comparisons easy.

Questions of whether to aggregate, what to aggregate, and how to aggregate raise challenging methodological issues, as well as fundamental conceptual issues that go to the heart of the meaning of sustainable development. One issue on which there appears to be fairly widespread agreement is that, to whatever extent aggregation is appropriate, it should be based on monetized units (i.e. total dollar value of capital). Very few participants in the ESDI Initiative supported an approach whereby an overall score is based on the aggregation of differently weighted indicators based on different units.

The debate on this issue focused on the prospect of developing a single aggregated, monetized indicator of the net value of national capital. For example, various participants suggested that stock value (as indicated in monetary units), rather than stock size (denoted in physical units), represents the most useful indicator in determining the importance of the role of a particular type of capital. This is because a monetized indicator provides a sense of resource scarcity, or value, of the particular resource to society. Also, indicators of stock sizes or quantities can lead to confusion about the relative availability of a particular natural resource. For example, while total stocks of non-renewable resources decline as they are used, in

many cases the total proven reserves—the amount available at commercially viable prices—may be increasing.

Some participants also expressed a preference for an aggregated, monetized measure that would respond to the question “Are we saving enough for the future?” This is the function that could be served by the Net National Wealth Indicator described in section 5.1.4.

There are two important reasons why the NRTEE is not recommending a single aggregated, monetized indicator of Canada's net capital. Considerable academic work on the topic of monetizing the economic contribution of environmental assets has taken place over the past two decades. While work on this topic is proceeding, there remain several areas of controversy associated with the different methods of monetizing capital.

More fundamentally, an aggregated, monetized indicator is only appropriate if one assumes that all types of capital can be substituted for one another. If all capital is substitutable, it is unnecessary to report different forms separately. All that is relevant is whether the aggregate amount is increasing or decreasing. We know that some forms of capital are relatively easily substitutable for one another. For instance, machines (produced capital) can often substitute for labour (human capital). New fuel sources may substitute for oil and gas in the future (one form of natural capital substituting for another).

There may be some types of capital, however, that are so important and so difficult to replace that it may be inappropriate to assume complete substitutability. As a society, we may not want to trade off dirty air—reduced natural capital and possibly reduced human capital (health)—for economic gains in the form of enhanced produced capital. At a minimum, large-scale replacement of all ecosystem services would be expensive and disruptive to society. In addition, ecosystems provide a variety of functions that we do not yet fully understand and therefore cannot

value properly. For example, even though we are able to substitute swimming pools (a type of produced capital) for beaches that have become unswimmable, we are aware that beaches serve other social and ecological purposes. But because we do not fully understand all these other functions, the unforeseen consequences of degrading beaches and then replacing their services with produced capital may return to haunt us in ways that are more costly than finding ways to prevent beaches from becoming polluted in the first place.

Even among those participants who did not agree that some types of capital should be considered “unsubstitutable,” many acknowledged that it might be appropriate to develop physical indicators for common property aspects of the environment. Such indicators would be particularly relevant to policy, because the management of common property capital such as air and water must be coordinated to address the fact that the market does not automatically allocate a price to them.

The NRTEE has concluded that prudence dictates that Canada’s information system not assume that all forms of capital are entirely substitutable. Accordingly, at least for the foreseeable future, we should track certain types of capital independently of an aggregated measure. As sections 4 and 5 describe, the ESDI model therefore includes discrete indicators of some aspects of human and natural capital, while the expanded System of National Accounts will provide the basis both for tracking a broader set of capital assets and for developing an aggregate measure of those types of capital that can be credibly monetized.

6.3 WHICH INDICATORS?

Despite general support for each of the illustrative indicators selected, there were disagreements about the precise form of each indicator. For instance, certain participants in the ESDI Initiative would have preferred a different indicator of forest capital, because the indicator tracking the total extent of forest cover does not provide information on whether natural forests are being replaced with monoculture plantations.

As might be expected of an exercise that attempted to develop a small number of indicators to represent the vast diversity of Canada's natural and human capital, there were also many suggestions for additional indicators. Particular interest was expressed, for example, in including specific indicators for:

- marine species and/or ecosystems
- water availability
- quality of agricultural land
- land conversion, and
- biodiversity.

The NRTEE recognizes the importance of each of these items. The recommendation to expand the System of National Accounts is premised on the assertion that it will be important to track and report information on as wide a range of capital as possible. Ultimately, the expanded System of National Accounts should therefore include data on each of these important items, as well as numerous others.

One of the reasons for recommending additional indicators was a concern that a focus on a single “illustrative” indicator might obscure the interdependence of various dimensions of an ecosystem. A similar concern prompted suggestions that the NRTEE include indicators such as an “exploited species index” or a “habitat diversity index” that go beyond a single resource sector to deal in an integrated manner with the full range of living resources and the ecosystems in which they live. Many participants also recommended adopting indicators of more

systemic indicators of the quality or health of systems, as opposed to indicators of components of a system.

Some participants also argued that the overall set of indicators should provide additional information. Various participants, including representatives of the two Canadian organizations working to develop provincial “genuine progress indicators” (the Pembina Institute for Appropriate Development and GPI Atlantic), argued that the final set of indicators should include a consumption indicator such as the “ecological footprint.” Such an indicator would provide information to Canadians about the impact of their driving habits, energy use, consumption patterns, waste production, and/or other types of behaviour on the environment. Consumption indicators might also help highlight the important international dimensions of sustainability. In an increasingly interconnected world, some participants thought it might be inappropriate to rely solely on information about the impact of Canadians on natural capital within our national boundaries.

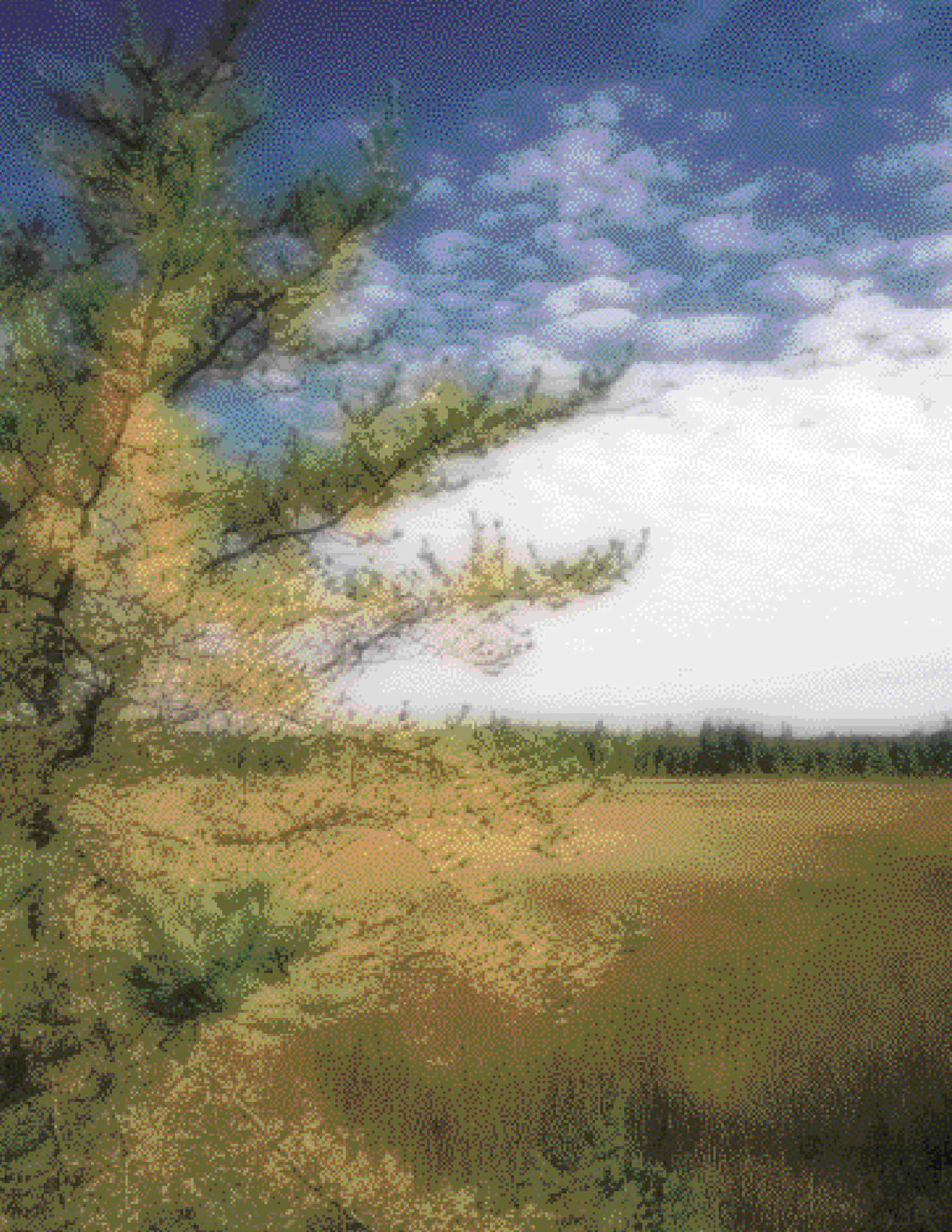
In a similar vein, some commentators also argued that the final indicator set should include information about the “pressures” faced by the various stocks of natural capital. Canada has been a pioneer in the development and use of “pressure–state–response” models of reporting on environmental quality, and continues to generate considerable useful information of this kind.

Although the NRTEE chose not to highlight either consumption or pressure indicators in its small set of representative indicators, it recognizes their importance and supports the continued development and publication of this information. Both the ecological footprint concept and the pressure–state–response models can involve capital indicators through underlying data sets.

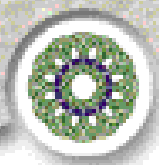
Chapter Seven

RECOMMENDED NEXT STEPS





Recommended Next Steps



The NRTEE's initial mandate was to recommend a small set of indicators that could be ready in the short term. However, the findings have also led to longer-term recommendations regarding the expansion of the System of National Accounts and increased accessibility of environmental data through implementation of the Canadian Information System for the Environment.

This section provides a suggested order of priorities for the implementation of the NRTEE's recommendations.

7.1 FIRST STEPS: REPORT AND REFINE THE RECOMMENDED INDICATORS

In addition to the GDP and other well-known economic indicators, the Government of Canada needs to begin reporting annually the recommended indicators of the state of Canada's natural and human capital. Ideally, these indicators should be reported by the Minister of Finance in each federal budget to illustrate the importance Canada attaches to these aspects of its capital assets.

The development and regular reporting of the indicators will require ongoing collaboration among various federal, provincial/territorial and

other organizations. As well, the government should ensure adequate funding to continue refining the indicators as required and to generate and analyze the data needed to produce the indicators annually. Funding should include targeted funding for CISE in the short term, since it is responsible for a number of areas that coincide with the natural capital indicators.

The recommended indicators are not all at the same level of development. The NRTEE has identified the following areas where work can most effectively be concentrated within the next few months:

- Freshwater Quality Indicator: Improve the national aggregation methodology, and work with the CCME and provincial/territorial governments to increase water quality monitoring to ensure a nationally representative network of water bodies.
- Forest Cover Indicator: Provide funds to improve the Forest Cover Indicator by using Canadian Forest Service data to verify the satellite data.
- Extent of Wetlands Indicator: Provide funding to develop an Extent of Wetlands Indicator based on satellite data.

7.2 LONGER-TERM ACTIONS

7.2.1 Expand and Reorient the System of National Accounts

Expanding the System of National Accounts will be a long-term undertaking, but it must begin now. Statistics Canada has laid the groundwork, through its pioneering efforts in developing accounts that track natural resources and timber and through its leadership role in fostering

international consensus on models for expanded national environmental statistics. Priorities for, the next steps in this process should be set through active collaboration among the Department of Finance, Statistics Canada, Environment Canada, Natural Resources Canada and other agencies responsible for collecting and analyzing the data necessary to support each indicator. This effort should take into account the needs of a wide range of potential users of the resulting data and indicators.

Adequate funding will be necessary to ensure that this effort leads to enduring change both in Statistics Canada and in all departments, agencies and other organizations that need to be involved in data collection, analysis and the incremental development of the accounts.

7.2.2 Support CISE

To generate the data necessary to develop national accounts for natural capital, the Government of Canada needs to work with all levels of government to improve the quantity and quality of national-level environmental information. The Canadian Information System for the Environment plays a central role in coordinating the provision of this information and should therefore receive stable, ongoing funding.

In addition to providing data for the indicators recommended above and the creation of expanded accounts within the SNA, CISE will play an important role in helping to develop and report on various new environmental indicators. CISE's role also includes providing ready access to a broad range of environmental information relevant to specific federal environmental mandates and activities (toxics management, ecosystem quality, climate change, species at risk, etc.). CISE will need appropriate funding for each of these new functions as they are developed.

7.2.3 Institutionalize the NRTEE's Recommendations

Although the NRTEE is formally handing over the recommendations of the ESDI Initiative to the federal government for implementation, it will make a concerted effort over the next year to promote the implementation of its recommendations. It will also strive to sensitize both the informed public and decision makers regarding the use of the indicators and the value of a broader approach to national accounting and environmental monitoring.

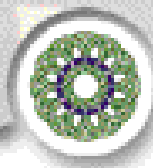
The timely and effective implementation of these recommendations will require the active and ongoing involvement of many organizations at all levels of Canadian society. At the federal level, the Department of Finance will need to take the lead role in committing to use the recommended indicators, in helping to shape priorities for the evolution of the SNA, and in helping to provide appropriate funding. Other federal players will include Statistics Canada, Environment Canada, Natural Resources Canada and Health Canada. Outside the federal government, the Canadian Council of Ministers of the Environment, various provincial agencies and numerous academic and non-profit organizations will play important roles as well in helping to provide and analyze information.

APPENDICES





Appendix A



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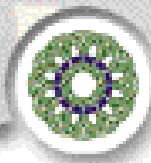
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Note: this program was carried out over a number of years; some participants' titles and/or organizations may have changed during that time.

Appendix B



Participants in Workshops with Potential Indicator Audiences

Workshop on the Framework for the Environment and Sustainable Development Indicators March 29, 2001

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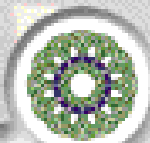
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Appendix C



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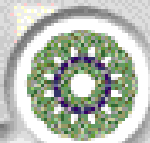
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Appendix D



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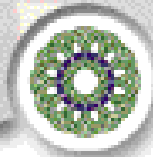
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Appendix E



Acknowledgements

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Endnotes

Introduction

- 1 The proceedings for major program events, as well as many of the ESDI Initiative's background and cluster group research documents, are available on the NRTEE's website at www.nrtee-trnee.ca. Page 4

The Capital Model

- 1 Organization for Economic Co-operation and Development, *The Well-Being of Nations: The Role of Human and Social Capital* (OECD, 2001). Page 15
- 2 Ibid. Page 16

National Indicators of Natural and Human Capital

- 1 It should be noted that the Fresh Water Quality Indicator measures only untreated water. Therefore, while some of the water quality objectives used in this indicator are related to potability, the indicator itself is not a measure of the safety of drinking water. Page 24
- 2 In Quebec, water quality was evaluated using an index methodology (L'indice de la qualité bactériologique et physico chimique) other than that of the CCME. Page 24
- 3 The Montreal Protocol controls substances that deplete the stratospheric ozone layer. Some of these substances are also greenhouse gases. Page 26
- 4 The concept of CO₂ equivalent provides a way to compare the emissions of various greenhouse gases based upon their global warming potential (GWP), with the effect of carbon dioxide being equal to one. Page 26
- 5 Greenhouse Gas Division, Environment Canada, *Canada's Greenhouse Gas Inventory, 1990–2000* (June 2002), p. 2. Page 26
- 6 Intergovernmental Panel on Climate Change (IPCC), *IPCC Second Assessment Report: Climate Change 1995* (1996). Page 27
- 7 For example: forests, land use change, agricultural soils. Page 28
- 8 UN Food and Agriculture Organization, *Global Forest Resource Assessment 2000 Main Report*, FAO Forestry Paper 140 (2001), Appendix 2 (www.fao.org/forestry/fo/fra/main/index.jsp?lang_id=1). Page 28
- 9 See Environment Canada, Lands Directorate, *Land Use Change in Canada. Wetlands in Canada: A Valuable Resource*. Fact Sheet 86-4 (1986); and Environment Canada, *The State of Canada's Environment* (Ottawa, 1996). Page 33
- 10 See: www.wetlandscanada.org. Page 33
- 11 Provinces with existing inventories or immediate plans to create inventories include Manitoba, New Brunswick, Nova Scotia, Ontario, Prince Edward Island and Saskatchewan. Page 33
- 12 Nova Scotia (province-wide), St. Lawrence Lowlands (Quebec), southwest Manitoba, north-central Alberta. Page 34

- 13 Organization for Economic Co-operation and Development (OECD), *The Well-Being of Nations: The Role of Human and Social Capital* (2001), p. 18. Page 34
- 14 These institutions include vocational schools, community colleges, Collèges d'Enseignement Général et Professionnel (CEGEP), and schools of nursing, as well as any type of apprenticeship training. Page 35
- 15 OECD, Centre for International Research and Innovation, *Human Capital Investment, An International Comparison* (1998). Page 35

A Better Capital Information Framework

- 1 Further details on the extension of the SNA can be found in the following document: Statistics Canada, *Building a Sustainable Development Information System* (2003). Page 39
- 2 Present measures of capital encompass all forms of produced capital (residential, commercial and institutional buildings; machinery and equipment; and inventories); the value of residential, commercial and agricultural land; consumer durable goods such as automobiles and major appliances; Canada's net financial assets held abroad; and standing timber and subsoil mineral assets. Page 39
- 3 This document is a revised version of the UN's environmental accounting handbook. It is expected that this report will be released in the summer of 2003. Page 40
- 4 See, for example, World Bank, *Expanding the Measure of Wealth: Indicators of Environmentally Sustainable Development*, Environmentally Sustainable Development Studies and Monograph Series No. 17 (1997). Page 43
- 5 Department of Economics, University of British Columbia. Page 43
- 6 See: John Livernois, "Determining an Aggregate Indicator of Sustainability for the ESDI Initiative," working paper prepared for the NRTEE (2002); and Ross McKittrick, "Determining an Aggregate Indicator of Sustainability: Using Changes in the Value of Total National Capital," working paper prepared for the NRTEE (2002). Page 43
- 7 Kirk Hamilton, *Genuine Saving as a Sustainability Indicator* (The World Bank Environment Department, October 2000). Page 43