

Sustainability in Professional Engineering and Geoscience:

A Primer

Part 1: Introduction

Developed by the Sustainability Committee of the
Association of Professional Engineers and Geoscientists of British Columbia
APEGBC

www.apeg.bc.ca

www.sustainability.ca





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Part 1: Introduction

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1 Context and Introduction

APEGBC Sustainability Guidelines

Core to APEGBC's articulation of sustainability are the Sustainability Guidelines that state that, within the scope of a Member's task and work responsibility each Member, exercising professional judgment, should:

- 1) *Develop and maintain a level of understanding of the goals of, and issues related to, sustainability*
- 2) *Take into account the individual and cumulative social, environmental and economic implications*
- 3) *Take into account the short- and long-term consequences.*
- 4) *Take into account the direct and indirect consequences*
- 5) *Assess reasonable alternative concepts, designs and/or methodologies*
- 6) *Seek appropriate expertise in areas where the Member's knowledge is inadequate*
- 7) *Cooperate with colleagues, clients, employers, decision-makers and the public in the pursuit of sustainability.*

The Association of Professional Engineers and Geoscientists of British Columbia (APEGBC) has developed a Sustainability Primer as part of its implementation of a Sustainability Management System (SMS). The Primer's purpose is to act as an initial step in raising knowledge of sustainability, and to function as a simple, readily accessible resource on sustainability for engineers and geoscientists. It is not meant to be a comprehensive manual on "how to engineer sustainably", but rather is intended as an aid to help engineers and geoscientists implement sustainability principles in the course of their everyday activities.

This document, **Part I: Introduction** of the Sustainability Primer, outlines general issues that provide context to all our sustainability activities as professional engineers and geoscientists.

Part 2: Applying the Guidelines, develops some suggestions for approaches for applying APEGBC's Sustainability Guidelines (left) across the spectrum of engineering and geoscience activities.

Part 3 is comprised of several practice-specific modules (collectively referred to as **Part 3: Practice-Specific Modules**) that are intended to assist practicing professionals apply these concepts and Guidelines in specific situations.

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Feedback is welcome. Please email: sustainability@apeg.bc.ca, or complete the form at:

<http://www.compassrm.com/active/apegbc/primer/>

2 Sustainability Questions and Answers

Q 1 What is sustainability?

With more than 300 definitions of sustainability, it's little wonder there is some ambiguity over what exactly the term means. The best-known definition comes from *Our Common Future* (the so-called "Brundtland Report") prepared under the auspices of the World Council on Environment and Development in 1987, which defines sustainable development as that which "...meets the needs of the present without compromising the ability of future generations to meet their own needs". While this hints at a number of important principles, it provides little concrete guidance about what to do differently.

In 1993, APEGBC took the position that sustainability from an engineering and geoscience perspective can best be understood as a *process of complying with seven principles*, known as the Sustainability Guidelines. The Guidelines, presented on page 10, essentially embody the following fundamentals of sustainability¹:

Systems Thinking

Acknowledging the fact that seemingly discrete projects or activities are in fact a part of many interacting or interdependent social, ecological, and economic systems that together form one complex global system. Such thinking encourages us to critically assess the boundaries we assume our projects or activities lie within, and to expand or modify those boundaries where appropriate.

Temporal and Spatial Scales

Assessing the environmental, social, and economic impacts of our actions over varying scales of space and time.

Risk, Uncertainty, and the Precautionary Principle

Identifying and actively managing risk and uncertainty; recognizing the value and limitations of both quantitative risk analyses and subjective risk perception in situations characterized by significant uncertainty; maintaining a level of precaution in the face of potentially major negative consequences that is cognizant of stakeholder concerns and values.

Values-Focused Thinking

Developing alternative solutions to problems based on human needs and values, and evaluating these options on the basis of those values.

Engagement & Integration

Engaging stakeholders and forming integrated design and consultation teams at the onset of appropriate projects to take advantage of a pooled body of knowledge to help define and solve the issues at hand.

Equity and Disparity

Ensuring that the equity and disparity of current and future generations has been considered and that a fair and consensus-seeking process is in place to ensure that the benefits and costs are distributed fairly among various stakeholders.

Efficiency

Seeking to maximize the contribution to wellbeing of humans and ecosystems while minimizing the stress on people and ecosystems, seeking win-win situations and clarifying irreducible trade-offs.

Process & Practicality

Applying sustainability in engineering and geoscience in practical and rewarding ways.

Perhaps paradoxically, sustainability is best seen as a dynamic process rather than a static end-point – within a small number of fundamental physical constraints at a planetary scale, the scope for living sustainably in the context of changing technology and human values is enormous.

Q 2 What's driving this interest in sustainability?

For engineers worldwide, interest in sustainability is being driven by a number of factors, including:

- 1) Mounting evidence that certain forms of technological and economic development are either physically or socially unsustainable, and that the usual feedbacks that modify development patterns might not reveal themselves in time for us to make those changes in a controlled and timely manner. In some respects, sustainability is taking a feedforward control philosophy to socioeconomic development in the hope of avoiding some of the negative impacts and inefficiencies associated with feedback control systems.
- 2) Social changes in the past forty years or so have lead to a more complex and demanding role for engineers and geoscientists in society. It is no longer acceptable (if ever it

was) for engineers to focus exclusively on technical issues; almost every “technical” decision has social, economic and environmental implications that we must recognize and balance in ways that reflect a complex mixture of interests and values. Increasingly, technical professionals of all disciplines (including physicians, for example) are obliged to be more open, inclusive and accountable in the way their skills are exercised.

- 3) Many engineers and geoscientists believe that embracing sustainability will help shift the focus of professional engineering leadership to a well-defined, confident and less defensive footing, and may enhance the otherwise waning image of engineering in society – one of the primary concerns of engineers throughout the western world.

Q 3 How is economic development currently unsustainable?

At various stages of history, human societies have engaged in a variety of activities that were literally unsustainable. Modern western societies have avoided collapse to date because technoeconomic developments have limited the duration of particular unsustainable activities; for example, in the early days of the Industrial Revolution, wood was used as a primary fuel and construction material at an unsustainable rate – until focus shifted to the use of coal and iron for a variety of technological and economic reasons.

Market forces have, in other words, proven quite adept at modifying human behaviour in time to avoid the negative impacts that would otherwise have resulted from continuing that behaviour too long. No doubt many of our current activities will be modified by the same mechanism without much conscious effort. However, several of the major information feedback loops upon which market forces now rely appear to contain within them sufficient uncertainties and lag times (and the activities are creating sufficient irreversibilities) that by the time reliable information is available to drive a market solution, the damage may have been done. Also, many of the foreseeable impacts appear likely to occur outside the time horizon of current political and commercial frameworks. Just as a process engineer would look to employ some form of feedforward controls to compensate for a delay in information feedback, so it makes sense for us to identify how we might modify current activities to avoid some of the negative unintended consequences of our actions.

There are many environmental, social, and economic “indicators” of sustainability that we can use to inform a feedforward control strategy. Some of these include:

Table 1: Changes in selected global sustainability indicators

Population	<p>From 1961 to 2001, human population doubled, to 6.2 billion. Forecasts show that the Earth’s population will grow to 9 billion by 2050ⁱⁱ. The significance of population on material sustainability can be approximated by the so-called “IPAT” equation, which suggests that the environmental impact over a given area (I) can be estimated by finding the product of appropriate indicators of population (P), affluence (A) and technological sophistication (T): $I = P \times A \times T$. Much has been written on the relative value of this approach, which has seen widespread application since its development by population scientists in 1972. Some of the debate centres around the metric for “T”, that some argue should be arch-shaped – increasing T increases I up to a point, but then begins to decrease I as advanced technologies become less energy and materially intensive.</p>
Climate Change	<p>Although climate change is a naturally occurring phenomenon, the Intergovernmental Panel on Climate Change now believes that there is “new and stronger evidence that most of the warming observed over the last 50 years is attributed to human activities.”ⁱⁱⁱ Climate change is not inherently negative, but human societies are not well prepared to deal with its likely impacts which, as this website developed by Natural Resources Canada describes, could be quite severe for British Columbia. On a global level, climate change may lead to widespread hardship, species loss and could introduce instability to a range of critical socioeconomic systems.</p> <p>http://adaptation.nrcan.gc.ca/posters/searchByRegion.asp?Region=bc&Language=en</p>
Ecological Diversity	<p>In the second half of the 20th century, the Earth lost 300,000 species, and species are disappearing between 100 and 1000 times faster than before Homo Sapiens evolved^{iv}. This rate of loss in diversity may be unappealing to us and may cause ecological instability, but also reduces our option value -- the option we have to take advantage of these species in the future, for medical, economic or other gain. For example, at least 25 percent of all modern drugs originally came from rainforests, and over 2,000 plants have been clinically shown to have anti-cancer properties^v.</p>
Energy Use	<p>Global energy use will increase by about 2% per year to 2010^{vi}. The vast majority of this will come from non-renewable resources such as gas, coal and oil, and more significantly, will create emissions that contribute to global climate change and local air quality problems.</p>

While these and related indicators report worrying trends, the Earth itself is, of course, a finite ecosystem. Like bacteria in a petri dish, there are limits to the extent to which we can use non-renewable resources and create waste before the reality of our planet’s scale begins to affect our lives. One way or another, sooner or later, logic demands that this lack of equilibrium must eventually end. Are existing institutions up to the task of ensuring that this occurs on terms favourable to us?

Q 4 Wouldn't the economic consequences of cutting back on our energy and material use be dire?

Not necessarily. In recent years, we have seen how wealth can be created in less energy- and materially-intense ways, primarily through the rise of the knowledge, high tech, media and tourism sectors. There's no reason why dematerialization and economic growth should be mutually exclusive, as the software industry can attest. Nor is there any reason why similar economic, social and environmental gains cannot be made in so-called "old-economy" sectors like mining.

Part of the process requires a paradigm shift in the way that we conceptualize the value of the products and services that are delivered to consumers. In the energy and mining sectors, for example, some companies have repositioned themselves as "energy service providers" or "mineral service providers" rather than as oil companies or mining companies. The former suggest a long-term mind set; the latter do not. Service providers may seek innovative ways to meet society's needs that are less resource or waste intensive— energy efficiency instead of new dams to meet growing energy needs, for example.

Q 5 Isn't sustainability just a front for "lefties" who believe that free markets are bad and should be regulated?

Unequivocally NO. There is no reason why the pursuit of sustainability should be anti-market or anti-business. Many of the problems highlighted by sustainability arise through market failures – failures readily conceded by neo-liberals. For example, the economically-libertarian journal *The Economist* advocates the use of carbon taxes to help markets recognize that fossil-fuel-derived energy use has negative environmental impacts that are currently "externalized" from trade considerations. Shifting taxes from things that we want to encourage (e.g. employment) to things we want to discourage (e.g. fossil fuel energy use) does not necessarily increase the overall degree of regulation imposed by governments, nor does it in any way limit the freedom of the market to create opportunities.

Q 6 What do environmentalists think of sustainability?

Sustainability generally aligns with most environmentalists' agendas. It's important to remember, however, that whereas many environmentalists are interested in "conserving nature" in some sense, sustainability looks to find the best balance of environmental, economic, and social considerations in any given situation. It's therefore likely that environmentalists will need to make the same kinds of compromises as other parties when it comes to developing more sustainable solutions.

The importance of communication and engagement of all communities of interest cannot be overstated. The mining industry provides good examples of rethinking approaches to optimizing economic, social and environmental development. In recent years, a number of initiatives have brought together stakeholders to discuss past mining legacies, both negative and positive, and to brainstorm the future of the mining industry^{vii}. The purpose of these processes has been to bring people together in a non-threatening environment to openly discuss their opinions about what mining has been, is, and should be in the future. Naturally, compromises will have to be made on all sides.

Q 7 What about corporations?

Corporate responses to sustainability vary tremendously. The rhetoric of sustainability is common, but so too are genuine attempts to implement sustainability principles, often in the most surprising sectors. Examples again include the oil and gas or mining sectors, which are in many cases at the cutting edge of activities, processes and technologies designed to minimize both environmental impacts and social externalities. Many of these developments are being spearheaded here in British Columbia.

It is important to remember that a corporation's ability to unilaterally change the world may be limited. The roles of many kinds of organizations, including governments, NGOs and professional associations, should equally be examined critically.

Q 8 What do social justice and procedural equity have to do with sustainability?

Quite often, decisions about development and the environment are made by a limited number of people who have little awareness of the needs of those who must live with the consequences. Engaging potentially affected people (stakeholders) in development planning processes not only leads to better decisions through the incorporation of a broader range of knowledge and values, but makes those decisions more transparent, comprehensible and acceptable. The more visible decisions become, the more accountable they become, and the less likely they are to lead to conflict and legal stalemate. If sustainability is about finding ways of living together over the long term, then empowering people to exert influence over their own lives is a crucial component of this.

3 Sustainability and APEGBC

Q 1 What's APEGBC's position on sustainability?

- 1993: APEG Initiates Sustainability Objectives
- 1995: Sustainability Guidelines
- 1996: Sustainability Committee created
- 2000: SMS initiated
- 2002: Sustainability Primer developed.

Sustainability is at the centre of APEGBC's vision for professional engineering and geoscience. APEGBC's corporate mission is:

“to forge a cohesive, able and articulate membership to lead in: the protection of public safety, health and well-being; the creation of value through engineering and geoscience, and the promotion and achievement of sustainability.”

Furthermore, the first principle of APEGBC's Code of Ethics alludes to the importance of sustainability:

“to hold paramount the safety, health and welfare of the public, the protection of the environment and promote health and safety within the workplace.”

Since the early 1990s, Council has consistently supported and encouraged the activities of its Sustainability Committee, by adopting the *Sustainability Guidelines* in 1995 and the *Sustainability Management System* in 2000.

Q 2 What are the Sustainability Guidelines?

The Sustainability Guidelines state that, within the scope of a Member's task and work responsibility each Member, exercising professional judgment, should:

- 1) Develop and maintain a level of understanding of the goals of, and issues related to, sustainability.
- 2) Take into account the individual and cumulative social, environmental and economic implications.
- 3) Take into account the short- and long-term consequences.
- 4) Take into account the direct and indirect consequences.
- 5) Assess reasonable alternative concepts, designs and/or methodologies.
- 6) Seek appropriate expertise in areas where the Member's knowledge is inadequate.

- 7) Cooperate with colleagues, clients, employers, decision-makers and the public in the pursuit of sustainability.

(See Part 2: *Applying the Guidelines*).

Q 3 What is the "Sustainability Management System (SMS)"?

The sustainability management system (SMS) is a holistic framework that is guiding the systematic consideration of sustainability issues throughout APEGBC. Developed after extensive consultation with the public, Members and APEGBC staff, the SMS incorporates an action plan covering such issues as revising EIT training requirements, introducing sustainability to practice reviews, developing periodic technology briefs and so on. Designed to parallel the ISO 14000 Environmental Management System model of continuous improvement, the SMS places a strong focus on planning, monitoring and reviewing the efficacy of actions.

Q 4 What new obligations will the SMS place on Members?

Initially none. The first stages of implementing the plan involve establishing internal procedures and mechanisms, primarily aimed at APEGBC's various committees. However, APEGBC members have shown a strong interest in the Association upholding best standards of professional practice. Ultimately, where current guidelines need to be amended, Council has made clear its readiness to do so.

Q 5 What difference will the SMS make?

The SMS will primarily shift the focus for the implementation of sustainability initiatives from the Sustainability Committee to the Association as a whole. Once fully implemented, the SMS will guide a co-ordinated approach to sustainability. For example, if the Structural Engineering Committee becomes aware of an interesting new cleaner technology that it believes warrants wider Member awareness, it will work with the Professional Practice Committee to develop a Technology Brief that will be circulated to Members via the Communications Committee. This will replace the current system of committees acting in isolation on various related issues.

Q 6 When will we start seeing something tangible?

The SMS timeline has four "semesters", with most of the substantive material being developed in the third and fourth semesters, towards the end of 2002. The implementation of the SMS is underway, but progress is limited in pace because of the largely voluntary basis upon which it depends. The Sustainability Committee warmly welcomes

any Members interested in actively participating or supporting in implementing the SMS, as well as in its other sustainability activities. Please contact the Sustainability Committee at APEGBC by phone (604) 430-8035 or by email sustainability@apeg.bc.ca for more information.

Q 7 Where does the Sustainability Primer fit into this?

The Primer is one of the action items detailed in the SMS.

Q 8 What are other engineering professional bodies in Canada and around the world doing?

To our knowledge, there are no official sustainability committees at any of the other engineering professional associations across Canada. On a global scale, there are a number of engineering professional associations actively involved in sustainability – particularly in the United Kingdom, Australia and New Zealand. The Federation of Engineering Institutions of South East Asia and the Pacific have an active sustainable development network of which the national engineering associations of Australia and New Zealand are members. Australia has also developed a virtual engineering library for sustainable development (AVEL-SD). This is a useful resource for searching for sustainability topics relevant to engineers and geoscientists. The UK Institute of Chemical Engineers last year hosted “Sustainability 2000”, an online conference introduced by Prime Minister Tony Blair. The UK Institute of Civil Engineers offers free briefing sheets on sustainability issues. The International Federation of Consulting Engineers (FIDIC) is also actively involved in promoting sustainability objectives. They have a number of documents that can be downloaded from their webpage.

4 Opportunities that the Pursuit of Sustainability Offers Engineers and Geoscientists

Improving our image

According to the 2001 Member Opinion Survey, 95% of APEGBC members believe the Association should do more to enhance the image of the professions. While public relations campaigns doubtless have their role to play, a demonstrated commitment to balancing social, environmental and economic considerations in every aspect of professional practice would be a powerful profile-raising and image-enhancing strategy.

Becoming a more potent political body

According to the same survey, 91% agree (53% strongly) that APEGBC should take a public stand on major issues that affect society and are relevant to the professions. Through its commitment to sustainability, APEGBC is making strong statement on the importance it attributes to long-term economic, environmental and public welfare. As such statements become turned into visible action, the Association will have an increasing louder and more credible voice on the whole range of issues of concern to British Columbians.

Developing a framework for continued professional development

Sustainability demands many skills of its practitioners. In addition to the specific technical expertise required for undertaking familiar tasks in innovative ways, we also need to acquire a broad base of basic knowledge from other practices to ensure that we can actively and meaningfully engage in multidisciplinary problem solving. Continuing professional development programs may benefit from the structure sustainability may be able to offer.

Adding value to the work we do for clients / customers

Many engineers believe that over recent years, engineering and geoscience services have become increasingly commodified, with well-defined tasks more often offered in discrete chunks to the lowest bidder. Sustainability offers engineers and their firms the opportunity to broaden the range and depth (and, therefore, value) of services offered to customers or clients, to become more proactive in defining and conceptualizing problems, and to assume more of a position of leadership on strategic issues. And of course, the more value we can add to customers, the more valuable we become to them.

Helping our firms identify and exploit new business possibilities

Sustainability is rapidly becoming an industry in itself, creating business opportunities for those with the skills to spot and exploit them. For example, more organizations are implementing “environmentally preferred purchasing” policies, which favour the products or services of companies that can demonstrate a commitment to sustainability. Government regulations are often amended, and public tastes and concerns evolve. Employees who are well aware of sustainability and its many dimensions will be well placed to anticipate and act on emerging new trends and market changes.

Improving job satisfaction

After years of routine, any job can become mundane. Adding consideration of the extra dimension of sustainability can help make familiar, important tasks more challenging and rewarding. Rather than simply following prescriptive codes or guidelines, sustainability encourages us to rethink our approaches to common problems, to start from first principles in developing innovative new ways of doing things.

Improving career prospects

The pursuit of sustainability increases engineers’ range of skills and the flexibility with which we approach any task; with this follows skill transferability and employability.

Supporting healthy communities

Sustainability promotes the use of inclusive processes for developing solutions to community needs. Research shows that the *process* by which a potentially controversial decision is reached is a primary factor in determining the public acceptability of that decision. By advocating the use of appropriate public processes, engineers and geoscientists can go a long way towards nurturing goodwill and avoiding conflict in our communities.

5 General Sustainability Links

The Basics

International Institute for Sustainable Development

<http://iisd.ca>

A Canadian institution with a wealth of information on sustainable development

SD Gateway

<http://sdgateway.net/default.htm>

A portal for accessing information on sustainable development in many different sectors and areas of work. A good place to start learning about sustainable development. (Click on "SD in Depth" for an overview of sustainability)

UN Commission on Sustainable Development

www.un.org/esa/sustdev/

Created December 1992 to ensure effective follow-up from the Earth Summit conference – one of the main sustainability conferences in the world, which occurs every ten years (the next one is September 2002 in Johannesburg). UNCSD is responsible for overseeing Agenda 21 – a 300-page plan for achieving sustainable development that was adopted from the 1992 Earth Summit conference in Rio de Janeiro.

Principles and Methods for Implementing Sustainable Development

The Natural Step – Canada

<http://www.naturalstep.ca/>

An international non-profit organization that uses a science-based, systems framework to help organizations, individuals and communities take steps towards sustainability.

The Bellagio Principles

<http://iisd1.iisd.ca/measure/1.htm>

A set of 10 guiding principles for achieving sustainable development. Developed by the International Institute for Sustainable Development in Canada.

APEGBC Sustainability Guidelines along with this Primer

www.apeg.bc.ca/library/sustain.htm

A set of 7 Guidelines developed by APEGBC in 1995. The 7 Guidelines are presented on page 10. The Guidelines are also available online at the above website. Part 2 of the Primer should address some of the more practical issues of how to implement the 7 Guidelines.

Environmental and Physical Realities

Worldwatch Institute

www.worldwatch.org

Publishes 2 yearly reports: The State of the World and Vital Signs. These are very useful resources for learning about important global environmental, social and economic issues.

UN Population Fund

www.unfpa.org

Produces a yearly report on the state of the world population. A good source of information on global issues affecting the health of humans & the environment.

Population Clock

www.census.gov/main/www/popclock.html

An interesting website showing the current population in the United States and the World.

Encyclopaedia of the Atmospheric Environment

www.doc.mmu.ac.uk/aric/eae/english.html

A good source of information on environmental issues mostly related to climate change. This is a good starting point if you would like to learn more about climate change and other environmental issues.

Carbon Dioxide Information Analysis Centre

<http://cdiac.esd.ornl.gov/home.html>

The primary global-change data and information analysis center of the U.S. Department of Energy. This is a good site to visit if you are looking for up-to-date data records of atmospheric gases like CO₂ as well as certain climate change trend parameters like temperature.

Intergovernmental Panel on Climate Change

www.ipcc.ch

Established in 1988 by the World Meteorological Organization and the United Nations Environment Programme to assess the scientific, technical and socio-economic information relevant for the understanding of the risk of human-induced climate change. The IPCC produces a number of reports assessing the state of climate change. They usually have a summary for policy makers, which presents their findings in a relatively short succinct document that is easy to follow and understand.

Environment Canada

www.ec.gc.ca

Canada's internet resource for weather and the environment. You can visit the "Green Lanes" for specific regions in Canada and learn about environmental and weather issues that are relevant to Canadians. Another good website to learn more about environmental issues.

IUCN – World Conservation Union

www.iucn.org/

This is a good resource to learn more about species conservation and ecology. The IUCN produces the IUCN Red List of Endangered Species each year. – a comprehensive list of endangered species.

World Energy Council

www.worldenergy.org/wec-geis

A good source of information on the global energy sector. They have a useful summary on trends in nearly all of the energy sectors (fossil fuel to wind to wave and tidal energy). These summaries also include information on how each form of energy is generated, including basic physics of the generation process.

Economics and Business

Global Reporting Initiative

www.globalreporting.org

An international multi-stakeholder effort to create a common framework for voluntary reporting of economic, environmental, and social performance. The GRI produces guidelines for sustainability reporting. A number of Canadian companies have implemented the GRI reporting method including BC Hydro (www.bchydro.com/environment), Suncor (www.suncor.com), and TransAlta (www.transalta.com).

Sustainable Business

www.sustainablebusiness.com

Contains 4 main sections: a monthly online magazine reporting on leading sustainability initiatives in the business world, a networking section for businesses interested in sustainability to get connected, a section on sustainability-related job postings (including engineering), and a library with useful information on web links, reports, databases, and books.

World Business Council for Sustainable Development

www.wbcsd.ch

A coalition of 150 international companies to promote sustainable development via the three pillars of economic growth, ecological balance and social progress. Contains a number of resources such as online newsletters, case studies, and guidelines.

Canadian Business for Social Responsibility

www.cbsr.ca

A not-for-profit, non-political organization of profit businesses committed to socially responsible policies & practices. Offers a variety of services for members and produces a number of useful reports on socially-responsible business practices.

CERES – Coalition for Environmentally Responsible Economies

www.ceres.org

A U.S. not-for-profit coalition of investors, advisors, analysts, environmental advocates, public interest groups and community groups. Involved in a number of activities – one being the Global Reporting Initiative, which was created by CERES (see link above).

Dow Jones Sustainability Index

www.sustainability-index.com/default.htm

Tracks the sustainability performance of more than 300 companies.

Country Statistics

Canada vs. the OECD

www.environmentalindicators.com

A report comparing Canada's environmental record to 28 other industrialized countries. Published by the Eco-Research Chair of Environmental Law and Policy at the University of Victoria. Canada unfortunately ranked 28th out of 29 nations according to the report.

OECD

www.oecd.org

Reports on the economic, social and environmental development of 30 industrialized nations. A good source of information on country statistics. Useful and informative publications summarising the state of various environmental, social and economic issues.

Sustainability Report of Canada

<http://sustreport.org>

An independent assessment of how Canada is doing in terms of sustainability. Something to keep in mind is that there are competing views on how to measure sustainability. Nevertheless, this site provides links to a variety of sustainability assessments and is a good resource for learning more about sustainability.

Books

The Ecology of Commerce: A Declaration of Sustainability

Paul Hawken, September 1994

Biomimicry: Innovation Inspired by Nature

Janine M. Benyus, May 1998

The Natural Step for Business: Wealth, Ecology and the Evolutionary Corporation (Conscientious Commerce)

Brian Nattrass, Mary Altomare, Brian Naijgrass, January 1999

Natural Capitalism: Creating the Next Industrial Revolution

Paul Hawken, September 1999

The Ingenuity Gap

Thomas F. Homer-Dixon, October 2000

Approaches to Sustainable Development: The Public University in the Regional Economy

Edited by Robert Forrant, Jean L. Pyle, William Lazonick, and Charles Levenstein,

November 2001

Engineering & Sustainability Links

APEGBC

www.apeg.bc.ca/library/sustainability/APEGsustainability.html

The APEG Sustainability Committee website contains information relevant to engineers and geoscientists. We publish a bi-monthly newsletter that is available to view or download from our website. All sustainability documents can be accessed from the website as well.

Fed. of Engineering Institutions of South East Asia and the Pacific Sustainability Network

<http://www.hkie.org.hk/feiseap/sdnet/index.htm>

The FEISEAP comprises the national engineering institutions of thirteen Asian and Pacific countries, which have joined in a cooperative network for sustainable development. They represent some seven million engineers, in one of the world's most rapidly developing regions. Their website contains links to relevant newsletters, documents, forums, policy-related discussions, and other interesting web resources.

FEISEAP – Australia

<http://sunsite.anu.edu.au/feiseap/index.htm>

The Australian branch of FEISEAP. Contains links, resources and a list of newsletters related to engineering and sustainability.

AVEL-SD – Australian Virtual Engineering Library for Sustainable Development

<http://avel.edu.au/avelsd/index.html>

An online searchable database containing links to websites relevant to engineering/geoscience and sustainability. You can search by theme or key word on topics ranging from transportation to biotechnology.

UK Institute of Civil Engineers

http://www.ice.org.uk/beta/icenew3/navigation/index_know.asp

ICE is actively involved in sustainability objectives. Go to their webpage (link above) and click on “Environment and Sustainability” to find current information on sustainability events in the UK as well as a series of “briefs” on sustainability and civil engineering.

Georgia Tech Institute for Sustainable Technology and Development

www.istd.gatech.edu

The Institute serves as the Georgia Tech advocate on sustainability, facilitating development and implementation of a comprehensive agenda for enhancing the curriculum, research programs, and campus management. A number of web resources and interesting research activities relevant to engineers and geoscientists with a particular emphasis on education.

The Engineers forum for Sustainable Development

www.asee.org/neic/efsd/

Jointly sponsored by the American Association of Engineering Societies (AAES) and the American Society for Engineering Education (ASEE). The mission of the Forum is to help promote the principles and practice of sustainable development. Newsletter available once every 3 months.

International Fed. of Consulting Engineers (FIDIC) – USITAWI Network for Sustainability

www.fidic.org/resources/sustainability/default.asp

This website has a number of useful documents for consulting engineers including business guidelines, conference proceedings, and consulting practice strategies for achieving sustainable development.

6 Endnotes

ⁱ Adapted and developed from a number of sources, including:

Hardi, Peter and Zdan, T.. **Sustainable Development: Principles in Practice**. International Institute for Sustainable Development. 1997.

Hodge, Anthony. **Getting Inside the Concept of Sustainability**. 2001 Course notes for ES 545, Sustainability in Practice 1. Royal Roads University. Pg: 9, 27, and 28.

Mining, Minerals and Sustainable Development North America Task Force. 2001.

ⁱⁱ US Bureau of the Census, International Data Base, 5-10-2000

ⁱⁱⁱ Intergovernmental Panel on Climate Change. Summary for Policymakers on the Third Assessment Report on **Climate Change 2001: Synthesis Report**. Approved September 29, 2001, Wembley United Kingdom. pg 4, 5.

^{iv} New Scientist,

<http://www.newscientist.com/hottopics/biodiversity/biodiversityupdate.jsp>.

^v http://www.rainforestweb.org/Rainforest_Information/?state=more

^{vi} US Energy Information Administration

<http://www.eia.doe.gov/oiaf/ieo/world.html>

^{vii} Two examples are the Whitehorse Mining Initiative of the nineties and the current Mining, Minerals and Sustainable Development initiative.