
Sustainable Production

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Edited by Glen Toner

Sustainable Production:
Building Canadian Capacity



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*This book is dedicated to Professor Bruce Doern,
a mentor, an inspiration, and a friend to three generations
of Canadian public policy scholars.*

At the heart of the assessment is a stark warning. Human activity is putting such strain on the natural functions of Earth that the ability of the planet's ecosystems to sustain future generations can no longer be taken for granted. The provision of food, fresh water, energy, and materials to a growing population has come at considerable cost to the complex systems of plants, animals, and biological processes that make the planet habitable ... Above all, protection of these assets can no longer be seen as an optional extra, to be considered once more pressing concerns such as wealth creation or national security have been dealt with ... Nearly two-thirds of the services provided by nature to human-kind are found to be in decline worldwide. In effect, the benefits reaped from our engineering of the planet have been achieved by running down natural capital assets.

– Millennium Ecosystem Assessment,
Living beyond Our Means

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The idea for this volume came from creating and teaching the Innovation, Science and Environment stream graduate seminar *Industrial Policy, Innovation and Sustainable Development* in the School of Public Policy and Administration at Carleton. The intent was to develop a Canadian source in an area in which the students were primarily reading literature written by American and European authors. Several generations of students in this class have read and critiqued earlier drafts of the chapters. Future classes will get the finished product.

Finally, I would like to thank my wife, Sylvia Haines, for her support and forbearance throughout the production of this book.

Introduction

If someone were to represent the Industrial Revolution as a retroactive design assignment, it might sound like this: Design a system of production that

- puts billions of pounds of toxic material into the air, water and soil every year
- measures prosperity by activity, not legacy
- requires thousands of complex regulations to keep people and natural systems from being poisoned too quickly
- produces materials so dangerous that they will require constant vigilance from future generations
- results in gigantic amounts of waste
- puts valuable materials in holes all over the planet, where they can never be retrieved
- erodes the diversity of biological species and cultural practices ...

The Next Industrial Revolution can be framed as the following assignment: Design an industrial system for the next century that

- introduces no hazardous materials into the air, water and soil
- measures prosperity by how much natural capital we can accrue in productive ways
- measures productivity by how many people are gainfully and meaningfully employed
- measures progress by how many buildings have no smokestacks or dangerous effluents
- does not require regulations whose purpose is to stop us from killing ourselves too quickly
- produces nothing that will require future generations to maintain vigilance
- celebrates the abundance of biological and cultural diversity and solar income.

– William McDonough and Michael Braungart,
“The Next Industrial Revolution,” *Atlantic Monthly*

1

New Century Ideas and Sustainable Production

Glen Toner and David V.J. Bell

In the end, sustainable development is not a fixed state of harmony, but rather a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are made consistent with future as well as present needs. We do not pretend that the process is easy or straightforward.

– World Commission on Environment
and Development, *Our Common Future*

Can we move nations in the direction of sustainability? Such a move would be a modification of society comparable in scale to only two other changes: the Agricultural Revolution of the late Neolithic, and the Industrial Revolution of the past two centuries. These revolutions were gradual, spontaneous, and largely unconscious. This one will have to be a fully conscious operation, guided by the best foresight that science can provide. If we actually do it, the undertaking will be absolutely unique in humanity's stay on earth.

– William Ruckelshaus, former head of the
US Environmental Protection Agency

For thousands of years, human beings lived sustainably on this planet. This was not due to a carefully thought out philosophical commitment to the concept of sustainability.¹ Earlier societies lived more sustainably than we do out of sheer necessity, because nature imposed limits that the technology available to them could not easily expand or overcome. Societies that challenged these limits typically paid the high price of decline or, in some cases, extinction.²

The industrial revolution gave modern societies the illusion of omnipotence, the reassuring belief that the limits of nature could be transcended by technology. Increasingly this belief has collided with the disturbing reality of global climate change, ozone depletion, degradation of marine and terrestrial ecosystems, and the myriad other human-induced threats to the earth's life support systems. As the Millennium Ecosystem Assessment reminds us, it is increasingly apparent that for our species to survive into the future, humankind must learn to live differently on this planet.

If the challenge of making development sustainable is the overriding imperative of the twenty-first century, an integral aspect of this challenge is to shift our economy toward sustainable production. The purpose of this book is to strengthen the Canadian presence in the sustainable production debate while making a meaningful contribution to international discussions and scholarship on new approaches to industrial production.

Developments since *Our Common Future*

This debate was triggered by the publication in 1987 of *Our Common Future*, the report of the World Commission on Environment and Development (WCED 1987), which called for fundamental change to our systems of production and consumption (see in particular Chapters 3, 5, 7, 8, and 9). *Our Common Future* can be thought of as the “seed pod” from which the idea of sustainable development exploded onto the world stage.³ The report emerged at a point in the late twentieth century when many people were growing increasingly anxious about the sustainability of both the existing industrial system and the global ecosystems that support life and commerce. The WCED concluded that “humanity has the ability to make development sustainable – to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED 1987, 8).⁴ The winds of change carried the idea around the world in the period between 1987 and the 1992 United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro (also known as the Earth Summit) and beyond. As Lafferty and Langhelle (1999, vii) have argued: “Though numerous critics have predicted a quick and definitive end to the idea, they have been proved decisively wrong. With the possible exception of democracy, there currently exists no more widely endorsed symbol of positive socio-economic and political change than ‘sustainable development.’ It is quite simply everywhere ... from the smallest local NGO, through all types of intermediate organizations and nation-states, to the United Nations, World Bank and European Union – it is what we are all (at least on paper) striving for.”

The idea “seed” of sustainable development sprouted a wave of international actions beyond Agenda 21 and the UNCED Climate Change and Biodiversity Conventions, including the World Business Council for Sustainable

Development (WBCSD), the Johannesburg World Summit on Sustainable Development, and new research initiatives at the Organisation for Economic Co-operation and Development (OECD), the World Bank, and the International Organization for Standardization (ISO), among others. It also spurred a range of domestic responses in governments, companies, universities, and research organizations in various nations. How successfully the “seed” germinated and grew depended on how fertile the institutional soil was in these countries. A ten-country comparative study entitled *Implementing Sustainable Development: Strategies and Initiatives in High Consumption Societies* analyzed the post-Rio implementation effort and placed Canada at the top of the “cautiously supportive” category, the middle tier of engagement by the OECD countries studied (Lafferty and Meadowcroft 2000, 412; Toner 2000).

In Canada, therefore, the institutional soil was reasonably fertile for growing the seed of the sustainable development idea. The National Task Force on the Environment and the Economy was formed in October 1986 to respond to the WCED’s May 1986 visit to Canada. Its 1987 report spawned the National Round Table on the Environment and the Economy (NRTEE) in 1989 (NTFEE 1987, 10). The Conservative government’s 1990 Green Plan was the outcome of Prime Minister Brian Mulroney’s commitment on the dais of the UN General Assembly to develop a sustainable development plan for Canada as recommended in *Our Common Future*.⁵ The Liberal government of Jean Chrétien subsequently created the office of Commissioner of Environment and Sustainable Development and established the House of Commons Standing Committee on Environment and Sustainable Development. It also mandated the development, and updating every three years, of Sustainable Development Strategies by government departments. Canada is the first country in the world to legally require department-level sustainable development strategies. Along the way, the International Institute for Sustainable Development and Sustainable Development Technology Canada were created, and several new or amended pieces of legislation, such as the Canadian Environmental Protection Act and the Canadian Environmental Assessment Act, included sustainable development as a formal goal. Federal departments, such as Industry Canada and Natural Resources Canada, integrated sustainable development into their statutory mandates (for a more comprehensive analysis of this period, see Toner 2002 and Dale 2001).

Agenda 21, the forty-chapter manifesto adopted by all the world’s nations at Rio, has been described as a “blueprint for the twenty-first century.” It highlights the importance of sustainable production in Chapter 4, which links production to consumption, and points out that a major cause of the continued deterioration of the global environment is the pattern of unsustainable consumption and production, particularly in industrialized countries. A number of UN conferences since Rio have adopted the formulation

of linking production to consumption, and have sought ways of making both more sustainable. From its inception, the UN Commission on Sustainable Development (CSD), which was established following the Rio Earth Summit to monitor progress in implementing Agenda 21, has identified “changing consumption and production patterns” as an “overriding issue” on its agenda.

Sustainable production can be thought of as a major subset of sustainable development. Its focus is on the systems by which industrial economies produce goods and services and the ways in which investment and production decisions are influenced by public policy. Sustainable production is dematerialized production. In its narrowest sense, it means minimizing energy and material extraction and throughput per unit of economic output. This entails, *inter alia*, product durability, energy efficiency, transforming wastes into raw materials, product redesign, and supplanting physical goods with knowledge goods. In its broader sense, sustainable production reduces material and energy use per unit of production while simultaneously improving environmental quality and improving social well-being. Sustainable production envisions an industrial system that would maximize resource efficiency, minimize environmental impacts, and replenish natural capital, while providing safe and satisfying employment opportunities. The public policy regime (tax system, regulations, information, incentives/subsidies) influences industrial practice and can be a facilitator of, or a barrier to, sustainable production by industry.

There are two aspects to the problem of production: what gets produced (sustainable products) and how it gets produced (sustainable production processes). These two aspects are not always recognized or appreciated. According to the Lowell University Center for Sustainable Production (2005):

Sustainable Production is the creation of goods and services using processes and systems that are:

- non-polluting
- conserving of energy and natural resources
- economically viable
- safe and healthful for workers, communities, and consumers
- socially and creatively rewarding for all working people.

Beyond the requirement that sustainable products be durable, easily recyclable, non-polluting, energy-efficient, and so on, further conditions must be met. The products should use appropriate packaging, have been subjected to a life cycle analysis, and be identifiable to potential consumers through a credible labelling procedure, such as a certification system developed by governments either on their own or in partnership with private and/or civil society organizations.⁶

As important as the kind of products produced in the new sustainable economy is the way in which these products are produced. One of the first industrialists to adopt sustainability as a core value for his company was Ray Anderson, founder and CEO of Interface Flooring. Anderson (1998, Chapter 5) describes sustainability as a mountain taller than Everest with at least seven “faces”:

- waste elimination
- benign emissions
- closed loop production
- resource efficient transportation
- renewable energy
- redesigning commerce
- supportive (“sensitized”) stakeholders.

Of these seven faces, four relate directly to the nature of industrial production processes, with emphasis on various ways in which production can be made cleaner and less material- and energy-intensive – in other words, more “eco-efficient.”⁷ While Robert Paehlke notes in Chapter 3 that sustainable production can be narrowly construed as “dematerialized production,” he reminds us that a broader perspective is necessary to comprehend the many facets of sustainable production: “The achievement of broad sustainability involves sustaining our economy and the resources on which it depends, sustaining the quality of human life and therefore non-toxic air, water, and land, as well as a quality climate, and sustaining biodiverse wild nature (both for its own sake and to sustain both resources and the quality of human life). Every material input extracted from nature impacts one or more of these objectives.”

To achieve the outcomes associated with this broader view will require more fundamental transformations of the economy than merely better production processes. This is where Ray Anderson’s notion of “redesigning commerce” comes in. A sustainable economy will be more about services than products. Instead of owning products like carpets, customers will contract with manufacturers to provide them with the benefits of high-quality flooring by a lease arrangement that allows the manufacturer to assume control of and responsibility for the product “from cradle to cradle.” As William McDonough and Michael Braungart (2002) argue, the goal of an “eco-effective” industrial system will be to design products and processes so that the non-toxic biological nutrients can be constantly recycled, whereas toxic technical “nutrients” can be constantly reused in closed-loop industrial processes. The aim is to ensure that the entire product is designed to be disassembled and recycled. This, in turn, will require different design features and a use of different materials.

But will customers accept these new arrangements? Interface Flooring's commercial "Evergreen" lease program has not been as popular as anticipated. Why not? What is needed to make it work? The importance of values and culture to the successful implementation of sustainable production is crucial. Anderson touches on this with his reference to "sensitized stakeholders." But who will make them sensitive to and supportive of these sustainability innovations? Who will help create an appropriate "culture of sustainability"? Pressure from large companies to "green the supply chain" is clearly one major driver (Willard 2002, 2005; Rowledge et al. 1999).

Once again, however, government must be factored into the sustainable production equation. In fact, government can and must play a number of different roles in helping "bend the curve" toward sustainability. It is important to ask how effectively Canadian governments are providing this kind of leadership. The public policy regime in Canada, and in other developed countries, is undergoing a period of transformation. While the existing taxation, regulation, information, procurement, and subsidization systems still, in many cases, support, or at least do not discourage, unsustainable production and consumption practices and habits, changes to these policy instruments are gradually appearing, partly in response to the growing critique of the policy system (Toner and Frey 2004). In February 2005, for the first time, a Canadian minister of finance, Ralph Goodale, appeared before the House of Commons Standing Committee on Environment and Sustainable Development to explain Finance Canada's position on using fiscal reform measures to achieve environmental and sustainable development goals. The movement toward ecological fiscal reform has been slow to gather strength in Canada (NRTEE 2002) but the Senate committee and several federal departments are now pressuring Finance Canada to employ economic instruments to help achieve Canada's Kyoto Protocol commitments and other sustainable development goals (Senate of Canada 2004, 2005). Finance Canada responded with a lengthy annex in the 2005 federal budget explaining the framework it will employ to evaluate environmental tax proposals (Canada 2005, 313-27).

But the question remains, when will human beings stop behaving like weekend visitors to the planet? What changes will be required in human behaviour, values, and systems to stop the pattern of unsustainable environmental, social, and economic development? The pursuit of a sustainable development trajectory requires the creation of sustainable production systems, which forces us to ask a series of tough questions.

How can –

- 1 industrial efficiency radically increase in order to extract four or even ten times as much productivity from the same throughput of energy and material resources?

- 2 product redesign reduce material content and eliminate or reduce toxic use during the product manufacturing, use, and disposal/recovery phases?
- 3 federal, provincial, and municipal policies support leading firms that are making investments and commitments and moving up the sustainable production ladder?
- 4 firms seize the opportunities offered by the triple-bottom-line orientation to ensure that they are internationally competitive and superior employers?
- 5 financial markets be encouraged to think beyond the next quarter and support innovative firms that are making investments that will improve society and the environment as well as the economy?
- 6 a tax system devised for an “empty world” where labour was scarce and resources were plentiful be reformed to serve a full world of 6-9 billion people where resources are increasingly scarce?

What –

- 1 values must change in order to overcome societal resistance to changes in our production and consumption habits?
- 2 are the barriers in the path toward a more sustainable future? Are they primarily technical, financial, policy, or psychological?
- 3 “disruptive technologies” now emerging will enable more economically efficient and environmentally restorative production and have an impact on society in the twenty-first century comparable to that of the automobile and personal computer in the twentieth century?

These are at least some of the key sustainable production questions being debated around the world, and Canadian public and private sector organizations, including universities, must strengthen their capacity to contribute to this debate. This book is a small contribution. While the critical literature on unsustainable production goes back to seminal works such as Rachel Carson’s *Silent Spring* (1962) and the Club of Rome’s *Limits to Growth* (Meadows et al. 1972), there has been a veritable explosion of both scholarly literature and industry/government/NGO publications on sustainable production following *Our Common Future* and the Rio Earth Summit. This literature has largely been generated in Europe and the United States, and much of it is cited in the following chapters. While there have been examples of Canadian firms and Canadian policy innovations discussed in this literature, they are very much the exception (see examples from Rowledge et al. 1999, and Hawken et al. 1999). A major advance in the development of a Canadian “literature” was the 2001 publication of a CD-ROM entitled *The Role of Eco-Efficiency: Global Challenges and Opportunities in the 21st Century* (Five Winds International 2001). The study sought to establish a body of Canadian experience through case studies of the innovative practices of fifteen companies, some

Canadian-owned, some foreign subsidiaries. Still, there is no question that there is a major lacuna in the Canadian literature on sustainable production.

This is not a traditional academic book in that only half the authors are university-based scholars. Interestingly, the fact that the others are practitioners underscores an important point. In Canada much of the cutting edge applied work is being done by consultants, who take ideas, concepts, and tools generated in other countries and apply them to the Canadian context on behalf of Canadian firms and government departments. Indeed, several of these authors are “change agents” who help companies develop the analytic tools and staff capacity to advance sustainable production within the firm and sector. Kevin Brady’s work with the Product Sustainability Round Table connects him to a number of major international companies that are sharing experiences and learning collectively how to implement sustainable production practices and environmental management systems in business decision making. Blair Feltmate, Brian Schofield, and Ron Yachnin have helped create new capital market instruments for the Bank of Montreal while monitoring the changes in attitudes and practices of the capital markets for the Conference Board of Canada. At Stratos, John Moffet, Stephanie Meyer, and Julie Pezzack have done pioneering work in Canada in the area of corporate sustainability reporting. Working in partnership with federal and provincial departments and leading Canadian firms, they have produced a detailed benchmark survey of corporate environmental and sustainability reporting to gain a better understanding of current practices and to identify opportunities for improvement. The following section will highlight some of the central themes of the sustainable production debate identified by the authors of this volume.

Part 1: Sustainable Production and Its Context

Bob Masterson introduces many of the key ideas, concepts, issues, and arguments that characterize the current state of the debate. Masterson traces the debate back to *Our Common Future*’s formulation of sustainable development, which contained within it two key concepts, that of “needs” and that of “limits,” “not absolute limits but limitations imposed by the present state of technology and social organizations on environmental resources and by the ability of the biosphere to absorb the effects of human activities” (WCED 1987, 8). In preparation for the Rio Earth Summit, the Business Council for Sustainable Development (it later changed its name to the World Business Council for Sustainable Development) created the concept of “eco-efficiency.” Eco-efficiency sought to reduce inputs of energy, toxics, and materials into the production process and to minimize the impacts of product use on the environment. This concept was a breakthrough development for industry and, as Elkington has argued, functioned as a “Trojan

horse” by getting environmental considerations into the boardroom. Nevertheless, it was criticized by others as being inadequate to meet the challenge of satisfying the needs of 9 billion people by the middle of the twenty-first century. Masterson explores the critique of eco-efficiency by McDonough and Braungart, Rees, and others.

Masterson provides a succinct and helpful summary of concepts such as industrial ecology, eco-effectiveness, biomimesis, the Natural Step, and ecological footprint, and the shift from a “goods production” to “service provision” economy, all of which call for radical resource productivity improvements. He then introduces the concept of corporate social responsibility (CSR). These concepts inform the analysis of other authors, with, for example, Moffet, Meyer, and Pezzack developing the theme of sustainability reporting in Chapter 7 and Feltmate, Schofield, and Yachnin focusing in Chapter 9 on changes in the capital markets to support sustainable production initiatives.

In Chapter 3, Robert Paehlke explores several sustainable production opportunities in a number of sectors, asking, “How do we gain sufficient foresight to intervene in terms of risk management without foreclosing economic and technological innovation?” He focuses on the choice and combination of policy instruments that improve risk decisions: “Innovation in sustainable production results from the intelligent anticipation of future trends and requires a climate that is likely to reward innovation.” Because he is not convinced that the market alone will establish the necessary economic parameters to motivate and foster a sufficient level of innovation, he sees a crucial role for government in sustainable production, a role that in part includes getting resource prices right. Unlike pollution, which generally results from a limited number of particular processes or substances within particular industries, and which can be ameliorated with a limited number of innovations and interventions, sustainable production involves all aspects of the economy – hence, the scope of the policy challenges.

Paehlke constructs his sustainable production framework by critiquing the existing “common sense” model (which he calls “economism”) that takes prosperity (as measured by GDP) to be the essential goal of society and the overwhelming objective of public policy. He borrows from Robinson and Tinker in arguing that two forms of decoupling are essential to move toward a sustainable society. One is the decoupling of economic output (GDP) from energy and material throughputs, especially the extraction of raw resources from nature. The other is the partial decoupling of social well-being from GDP per capita (that is, improving the quality of life faster than increases in wealth, or getting more for our money). The single bottom line orientation of economism is unduly one-dimensional, while sustainable development provides a framework that integrates increasing prosperity

with increasing social well-being and enhanced environmental sustainability. Ultimately, industrial production and public policy must support the integrated goals of sustainable development and not the narrow goals of economism.

The information and communication technology (ICT) sector has a paradoxical impact in that it contributes to dematerialization via automation, telecommuting, and the substitution of physical goods with knowledge goods, while simultaneously generating problems with toxic material content and end-of-life management of outdated computer and other ICT equipment. (Keith Newton and John Besley, and David Wheeler, Kelly Thomson, and Michael Perkin, address other dimensions of this paradox in Chapters 4 and 5, respectively.) Paehlke is generally optimistic about the role that can be played by the ICT sector, along with other knowledge-based industries such as pharmaceuticals, health care, education, financial services, and the public sector, in a modern industrial economy because of their potential for growth without adding commensurately and proportionately to overall energy and material throughputs. He is less optimistic about the role of Canadian public policy here. He cites the OECD's 2000 economic survey of Canada to show that historically the leading sectors of the new economy, such as electronic equipment and industrial machinery, have been disadvantaged by Canadian public policy relative to the resource-based sectors, which have benefited from policies favouring resource development and use, particularly in the non-renewable resource sector (oil, gas, metals, and minerals).

Paehlke assesses recent sustainable production innovations in the transportation, construction, and urban planning sectors: infill housing in the urban core to slow suburban sprawl; the integration of material recovered from old tires into asphalt roads; the design of automobiles for disassembly and recycling. He also considers some of the market and policy barriers constraining the widespread adoption of these and other innovations. He also reviews a series of sustainability threats in the agriculture and forestry sectors in Canada, and some potential sustainable production opportunities for reversing many of these threats, including developments in the ethanol fuels area. Energy and resource pricing continue to be a major determinant of policy outcomes in his analysis. His hometown example of the multiple sustainable production benefits from a sophisticated piece of capital equipment (an industrial-scale laundry machine) built in Germany leads Paehlke to state: "One can only conclude that nations and industries that anticipate the resource limitations of tomorrow are likely to prosper in the face of global adversity ... Even if Canada has a relative abundance of water, trees, and energy it is in our best interest – environmentally, socially, and, in the long run, economically – to proceed as if we did not."

Part 2: The Knowledge-Based Economy, Social Capital, and Product Design

Keith Newton and John Besley argue provocatively in Chapter 4 that while the knowledge-based economy (KBE) has the potential to advance or impede sustainability, public policy innovations can help tilt the overall “social preference function” and “production possibilities frontier” in a positive direction. In their view, “certain features of the KBE – the emphasis on scientific and technological advance, continuous innovation, increased educational attainment, growing public concerns, the analytical and communication power of ICTs, dematerialization, and growing understanding of the mutually complementary objectives of eco-efficiency in firm performance – hold out the prospect of successfully addressing the admittedly daunting challenges.”

They develop a model that argues that at the level of the firm, sustainable production should be a core component of the new business paradigm of the KBE. They explore the internal and external factors that motivate firms to adopt sustainable production practices and emphasize the growing salience of tools that focus on product life cycles, particularly on the crucial design stage. They note that many of the required models, tools, indicators, and resources (such as inventories of environmental technologies, best practices, case studies, etc.) reside in international institutions. The challenge of building Canadian capacity will depend, in part, on our ability to use, refine, and extend them for use in specifically Canadian situations (as was done by Stratos in *Stepping Forward* [2001] and *Building Confidence* [2003]). They explore the strengths and weaknesses of ICTs in promoting sustainable production, underscoring the positive role of ICTs in developing and disseminating knowledge, which helps build social capital and a supportive global constituency.

The role of the ICT sector in advancing sustainability and bridging the digital divide is also the focus for David Wheeler, Kelly Thomson, and Michael Perkin in Chapter 5. The digital divide has many dimensions (urban/rural; generational; economically engaged/disengaged, north/south). Wheeler and colleagues explore some of the positive and negative impacts of ICTs to date (and there are plenty of both), as background for assessing how business, government, and civil society organizations might partner to enhance social inclusion in both the developed and developing worlds. In fact, they argue, “because of the highly networked and relationship-dependent nature of the sector, there can be few industries of greater interest to social capital and sustainable development theorists than those reliant on ICTs.”

They develop a conceptual framework that marries social capital and sustainability, and then apply the framework to some very interesting original research they have undertaken as part of the Sustainable Canada initiative. The research explores Canadian ICT sector attitudes toward sustainability

and social capital in a number of Canadian-based ICT firms. One interesting finding from the research was that the internal drivers for pursuing sustainability (the need to deal with the waste generated by ICT hardware, and the values of ICT sector employees) were stronger than the external drivers (pressure from NGOs and governments). Interestingly, from a national competitiveness perspective, Canadian ICT opinion formers felt that there was greater leadership in Europe and that Canada needed stronger leadership from both government and the major sector players. Overall, they conclude that “there are no intrinsic barriers to ICT firms pursuing sustainability as a sector and/or as individual firms committed to creating economic, social, and ecological value for stakeholders. Of course, there are no guarantees that the sector in Canada will deliver such value, but at least there seem to be no philosophical barriers.”

In Chapter 6, Carey Frey extends the focus of this section on technology and systems of innovation by analyzing the design professions and one of the dominant inventions of the industrial age, the automobile. Building on the eco-efficiency/eco-effectiveness debate introduced by Masterson, he develops an analytical framework for sustainable product design that highlights McDonough and Braungart’s three broad sustainability categories: equity or social justice, economy or market viability, and ecology or environmental intelligence. “A new design must strive to optimize each of these three components of the sustainability triad ... The individual innovators who can combine the various criteria for sustainable production with their design and engineering skills will successfully drive this next industrial revolution.” While innovations of this nature are possible, they are not yet the norm, and Frey critiques the dominant educational system for engineers and architects, which maintains the status quo, while underscoring the profound importance of the design stage on the life cycle impact of products and infrastructure.

Frey outlines the cultural, institutional, and economic factors that create barriers to sustainable production innovations in the training and employment of design professionals. He shares the viewpoint of Hawken and the Lovinses that no better high-leverage investment in the future could be made than “improving the quality of designers’ ‘mindware’ – assets that, unlike physical ones, don’t depreciate but, rather ripen with age and experience” (Hawken et al. 1999, 111). He highlights a recent example at the University of Michigan College of Engineering. The Concentrations in Environmental Sustainability, or “ConSenSus,” program is designed to broaden the education of engineers by informing them about environmental regulations, policies, practices, and the implementation of clean technologies so that they can anticipate and help circumvent potential problems. A key pedagogical element of the ConSenSus program consists of case studies

brought to the classroom by engineers from Ford, DaimlerChrysler, Dow Chemical, Pfizer, BP Amoco, and General Electric.

Ford's case study focused on the sustainable business case for rehabilitation of the firm's famous Rouge River manufacturing complex. William Clay Ford asked William McDonough to inspire and lead the remaking of the eighty-year-old "obsolete environmental catastrophe" into "the model of twenty-first century manufacturing." Based on McDonough's work in turning around the Rouge River complex, Ford asked McDonough to join the design team to develop Ford's Model U, which the company hopes will have the same impact on automotive production in the twenty-first century that the Model T had in the twentieth century. McDonough and Braungart wanted to use the opportunity to encourage the design team to shift from an eco-efficient strategy to pursuing eco-effectiveness, or positive environmental effects through intelligent design. This may seem like a tall order for the consumer product that has arguably had more impact on society and the environment than any other over the past century. Frey assesses the quite extraordinary design features of the Model U, including, for example, the supercharged hydrogen internal combustion engine, soy-based seating foams and tailgate resins, corn-based canvas roof and carpet mats, and many high-tech driver convenience, entertainment, and safety features. The development of the Model U as a concept vehicle raises a multitude of interesting questions that Frey explores – about eco-effective innovations and about the institutional, infrastructural, and attitudinal changes that will be required to support the full-blown diffusion of such innovations into the mainstream of society. Frey speculates that "the concepts of sustainable production, eco-effectiveness, and the Model U suggest that design professionals, a linchpin of the KBE, may be on the frontier of a transition from the ICT revolution at the end of the twentieth century to a new era of eco-innovation. There are, however, considerable technological obstacles that must be overcome before concepts such as the Model U are fully realized."

Part 3: External and Internal Drivers of Sustainable Production

The four chapters in this section focus on changes in the behaviour and mindsets of firms that are required for a sustainable future. Public policy is a prominent driver in creating the conditions for change in the norms and practices of firms. The key relationship is between industrial and environmental policy. The incentives, constraints, and signals provided by public policy and the emergence of a number of industry-generated tools and strategies are explored in these chapters.

In Chapter 7, John Moffett, Stephanie Meyer, and Julie Pezzack identify what they term the "twin dynamics" of sustainable production and consumption. These are the recognition by firms of: (1) the growing environmental

pressures of an increasingly crowded and affluent world that are starting to threaten the ecological processes that sustain human life and underlie our economic prosperity; and (2) opportunities to improve corporate image and enhance market share, productivity, profitability, and competitiveness by adopting new, more environmentally benign modes of doing business.

Reflecting the debate outlined by Masterson, the authors align themselves with those who argue that an environmental protection/eco-efficiency approach is inadequate, in part because more efficient production may have the paradoxical effect of reducing the cost of products and thereby increasing levels of consumption. They are attracted to McDonough and Braungart's idea of "eco-effectiveness," which is a model of human industry that is "regenerative rather than depletive" and in which products work within "cradle-to-cradle" rather than "cradle-to-grave" life cycles. They also approvingly cite Hawken and colleagues' four dimensions of "natural capitalism" (1999): dramatically increasing the productivity of natural resources; shifting to biologically inspired production models; moving to a solutions-based business model; and reinvesting in natural capital. They identify the carpet company Interface as an example of a firm that has redesigned both its product and its production process to significantly reduce energy consumption, eliminate the use of almost all toxic substances, and reduce almost all waste from its factories. Interface also wants to shift from selling carpets to leasing "floor-covering services." This would enable it to maintain the carpet during its use phase and take it back at the end of its life. This provides the company with a powerful incentive to design products that are durable, easily maintained, and readily recyclable. The question addressed in Chapter 7 is: "What public policies are required to induce other companies to follow [Interface's] example, or to do even better?"

The authors argue that to become a widespread, underlying element of our business culture, sustainable production requires: (1) mutually coherent environmental and industrial policies focused on stimulating and disseminating innovation; (2) new mechanisms and measures for enhancing awareness of opportunities for change on both the demand and supply sides; and (3) price signals that eliminate inappropriate subsidies and start to incorporate environmental externalities. They explore four key policy measures that could help support these reforms: smart regulation; more use of "soft" instruments and partnerships; information disclosure programs; and ecological fiscal reform (EFR). In discussing EFR, they note that recent studies have estimated the value of the earth's ecosystem services at over \$33 trillion a year, "yet, because the value of these services does not appear on any balance sheet, companies account at most for their use of resources, not for their impacts on ecosystem functions." EFR entails: (1) removal of all existing fiscal disincentives to environmentally sound practices; (2) use of eco-taxes to help internalize the true costs of production and consumption; (3)

selective use of incentives to encourage desired behaviours (e.g., accelerated capital cost allowances for energy and material-efficient technologies); and (4) development and use of new measures of progress that account more fully for environmental impacts than the current system of national accounts (NRTEE 2002, 2003).

One important new private sector sustainable production tool that the authors' consulting firm, Stratos, has helped pioneer in Canada is corporate sustainability reporting. The objective is to develop generally accepted sustainability accounting principles similar to principles and reporting frameworks that currently exist for financial statements and annual reports. Responding to the leadership of the Global Reporting Initiative to develop and disseminate guidelines for organizations to use for reporting on the economic, environmental, and social dimensions of their activities, products, and services, Stratos has taken a reporting methodology developed in the United Kingdom by SustainAbility and applied it to Canada. In *Stepping Forward: Corporate Sustainability Reporting in Canada* (2001) and *Building Confidence: Corporate Sustainability Reporting in Canada* (2003), Stratos has completed the first two in-depth benchmark surveys of corporate sustainability reporting in Canada. The third survey will be published in early 2006. This pioneering work, which resulted from a positive public/private partnership, has generated a better understanding of current reporting practices and their drivers and barriers, and has identified opportunities for improvement.

In Chapter 8, Mark Jaccard focuses on a new generation of regulatory instruments that can mobilize producers toward sustainable production. He is concerned about the wide gap that exists between our current environmental and industrial policies and the policies that are needed to shift us toward a more sustainable path. He arrays the traditional policy instruments (tools) along a continuum of "degrees of compulsoriness." His critique of the existing arrangement is that the most effective tools, such as command and control and environmental taxes, are the most compulsory and therefore least acceptable to industry, consumers, and politicians. The less compulsory information, moral leadership, and subsidy tools are highly acceptable to these constituencies, but because of their voluntary nature, they tend to be less effective. For Jaccard, the challenge is to develop policies that would achieve both effectiveness and acceptability to individuals and firms (i.e., not be seen as unfair or overly compulsory). He feels that EFR, levying of environmental taxes, and recycling of the revenue to reduce income and employment taxes and fund environmentally positive initiatives (such as vehicle feebates), may eventually emerge as a dominant policy instrument. He doubts, however, that current attitudes, particularly in North America, will allow this to happen across the broad policy spectrum in the short term.

Hence, to find a balance between accountability and effectiveness and to enhance economic efficiency, he proposes a focus on market-oriented, sector-specific regulations. He presents three examples of such tools and discusses their prospects for policy design and application: (1) sulphur dioxide emission cap with tradable permits in electricity generation, (2) the renewable portfolio standard (RPS) in electricity generation, and (3) the vehicle emission standard (VES). The success of the US sulphur dioxide cap and trade approach in reducing sulphur dioxide emissions and in stimulating additional health and economic benefits is outlined. The RPS has been adopted by half of the US states (DSIRE 2005) and several European countries and Australian states. Because polluting sources of electricity are currently not required to fully reflect the full environmental costs they cause, clean, renewable electricity technologies (solar, wind, running water hydro, wave and tidal generators, and geothermal energy) will require policy support until their costs fall as a result of commercialization and economies of scale. The RPS regulates the sellers of electricity, requiring them to procure a minimum percentage of the electricity they sell from renewable sources. There is no guaranteed electricity price for renewable electricity, only a guaranteed market share. Each producer decides whether to produce some renewable electricity themselves or purchase it from an independent producer. Trading mechanisms among producers mean those with the lowest costs will generate renewable electricity for the entire market. The market share targets vary with jurisdictions, and there are substantial penalties for non-compliance.⁸

The VES was established in 1990 by the California Air Resources Board. The policy requires that a minimum percentage of vehicle sales be of low-emission vehicles. Individual automakers must meet the standard as a fleet average of retail sales in California. A flexibility provision allows for trade between manufacturers so that the total vehicle fleet meets the standard even if individual manufacturers fall short. Automakers were given considerable lead times between target setting and target dates to provide enough time for the required technological change. Jaccard argues that the VES has played a key role in the emergence of revolutionary new vehicle technologies, notably electric/gasoline hybrids, battery electric, and fuel cell electric. Indeed, automakers are now trying to outcompete one another to capture this market, as reflected in recent research funding, commercialization efforts, and marketing strategies. A growing number of other US states have adopted the California standards and even enacted provisions to ensure that their standards adjust automatically if California modifies its VES.

After reflecting on the comparative advantage of such market-oriented, sector-specific regulations, Jaccard notes that, thus far, Canada's policy makers have been slow to adopt market-oriented regulations but that this may be changing. None of the "traditional" Canadian "barriers" of market size, jurisdictional coordination, and institutional inertia are insurmountable, and

the federal and provincial governments are increasingly likely to experiment with what looks like an exciting new approach to balancing the diverse policy design objectives of cost-effectiveness and public acceptability.

Linked to the new tools identified by Moffett and his co-authors and Jaccard are new tools emerging in the capital markets that provide new insights into corporate behaviour and performance from a sustainable production perspective. In Chapter 9, Blair Feltmate, Brian Schofield, and Ron Yachnin discuss developments in the financial markets that are helping to drive advances in corporate sustainability reporting and new trends in investing. This work builds on their groundbreaking report for the Conference Board of Canada, *Sustainable Development, Value Creation and the Capital Markets* (Feltmate et al. 2001), which was the first major Canadian study to confirm that firms that have embraced sustainable development as a guiding principle are being recognized as superior investments. The adoption of sustainable production practices that minimize a firm's environmental impacts while simultaneously contributing to the economic and social development of the communities they operate in shows that these firms have a management orientation that goes "beyond compliance" and thinks long-term. Banks and insurance companies are acknowledging that firms managed in this fashion are a superior risk and hence their bank loan rates and insurance premium rates tend to be lower. Such firms usually practise the eco-efficiency credo of "doing more with less," seeking to reduce energy input, material requirements, and waste per unit of production. These companies tend to have better employee satisfaction and retention rates and easier access to new markets. All of these characteristics generally have a positive impact on share price appreciation.

It is not surprising then that the evidence is growing that funds and indices that invest in such firms are outperforming the market. The number of funds that employ a positive or inclusionary screen for SD practices is growing, and these funds are distinguishing themselves from traditional socially responsible investment funds that employ a negative screen for firms in the tobacco, gambling, alcohol, and weapons sectors. EcoValue 21™ in the US, the joint Swiss/US Dow Jones Sustainability Group Index, and the Norwegian/US Storebrand Scudder Environmental Value Fund are three of the best known and most successful. The Storebrand Scudder Environmental Value Fund employs nine eco-efficiency criteria to screen the environmental performance of a company: energy efficiency, global warming contribution, ozone depletion impact, material efficiency, product characteristics, quality of environmental management, toxic emissions, water use, and environmental liabilities.

Several changes in public policy are supporting this trend. Amendments to the UK pension fund regulations in July 2000 require funds to report whether they take account of the environmental, social, and ethical impacts of their

investments. As a result, pension fund managers and financial analysts are seeking out companies whose shareholder value is enhanced, or at least protected, by prudent management of environmental and social risks. Feltmate and co-authors argue that perhaps the most far-reaching impact of these amendments is that they reverse the onus on pension fund managers by allowing sustainable development to be factored into the investment decision-making process without violating fiduciary responsibilities to maximize return: “In fact, recognizing the value creation and lower risk associated with sustainable development practices, it is now arguable that investment decisions made without assessing the environmental, economic, and social practices of companies may stand in violation of fiduciary responsibility.”

While not as proactive as the UK initiative, regulators in the US, Ontario, and Manitoba made decisions in the 1990s that allow for the inclusion of SD criteria in mutual funds and pension plans. The UK changes have put pressure on firms trading on the London Stock Exchange to itemize and account for all their risks – financial, environmental, social, and ethical – and report on them at year-end in corporate reports. The Financial Times Stock Exchange (FTSE) announced the launch of the FTSE 4Good Index series to provide tradable benchmark indices. Other fund managers have launched funds based on the index. These are early days in the inclusion of sustainable development criteria in the orientation of the financial markets, and once again Canada is following developments started elsewhere. While a number of methodological issues need to be worked out to overcome remaining barriers to this process of moving SD investing into the mainstream of industry practice, this important new tool has the potential to significantly alter attitudes and behaviour in the corporate sector.⁹

Kevin Brady’s chapter builds on the arguments presented in the preceding three chapters on the growing influence of external sustainable production drivers, by focusing on drivers and barriers internal to firms. Ultimately, for sustainable production values and changes to become embedded in the culture of a firm, the executive suite has to not only “buy in” but lead. As Brady notes, sustainable development has been characterized as a journey, not a destination. In the words of *Our Common Future*, “sustainable development is not a fixed state of harmony, but rather a process of change” (WCED 1987, 9). Indeed, Brady acknowledges that the sustainable production practice and value changes that flow from a firm’s adoption of a sustainable development orientation may vary depending on whether the firm is in the resource extraction, financial, manufacturing, or retail sectors. One factor common to the journey along the sustainable development path, however, is this crucial role of senior management.

Brady analyzes the various dimensions of this large-scale change process, discussing the role played by crises, emerging analytical tools such as management systems and stakeholder engagement processes, “change agents”

within the executive suite and board of directors, benchmarking, industry leaders outside the firm, and the increasingly sophisticated assessment tools for identifying both business risks and opportunities. Because he has both studied the corporate change process and worked closely with firms in a broad range of sectors attempting to embed sustainability practices and values into the organizational culture to ensure that real change takes place, Brady has a very strong sense of the barriers that exist and methods for overcoming them. Two are: (1) developing sustainable production terminology that the company leadership is comfortable with and that makes sense given the firm's size, location, and sector; and (2) overcoming the limitations of disciplinary training by finding ways to discuss sustainability that connects with the economists, accountants, lawyers, and scientists who occupy different functions within the executive suites.

In the concluding chapter, we integrate some of the key messages of the preceding chapters to show how the idea of sustainable production has grown over the past twenty years. We go on to explore further the role that public policy can and should play in supporting the growth of sustainable enterprise. We close by presenting four areas for further research.

Notes

- 1 Although it is true, of course, that most Aboriginal and so-called primitive societies have viewed nature very differently from "advanced" industrialized societies and typically treat nature with reverence and respect. In the Haudneshane language, for example, the word for "mother" means "you who gave me life." The concept of "Mother Nature" entails the notion of "you who makes all life possible."
- 2 There are many examples like that of Easter Island, often cited as a prototype of societies that ignore or attempt to transcend environmental limits and suffer the consequences.
- 3 Sustainable development was actually introduced into scientific discourse in the 1980 *World Conservation Strategy*, but remained largely within the domain of the scientific community until it was "popularized" by *Our Common Future*.
- 4 While many authors have attempted to develop modified definitions of sustainable development, none of these has gained the stature to supplant the WCED definition, which continues to be used by international organizations, government departments, companies, and civil society organizations. Sustainability is often used as a synonym for sustainable development. In Agenda 21, the terms "sustainability" and "sustainable development" were used interchangeably, and that is the case in this volume.
- 5 The Green Plan stated: "*Our Common Future* ... quickly captured the world's imagination with the concept of sustainable development [which it described] as activity in which the environment is fully incorporated into the economic decision-making process as a forethought, not an afterthought. It holds that resources must be treated on the basis of their future, as well as their present, value. That approach offers genuine hope of economic development without environmental decline" (Canada 1990, 4).
- 6 The German Blue Angel, the American ENERGY STAR, and the Canadian Eco-Logo certifications are examples.
- 7 Note the discussion by Bob Masterson in Chapter 2 of the "Factor 4" economy (possible with existing technology) and the much more ambitious "Factor 10" economy (which will require new technology and industrial and commerce redesign).
- 8 The government of Ontario introduced a similar tool when it committed to the development of new renewable sources of electricity generation with a goal of 5 percent by 2007

and 10 percent by 2010. In December 2004, the government announced ten new projects equal to 395 megawatts of renewable power; in March 2005, it announced a new request for proposals that will seek an additional 1,000 megawatts of renewable energy (Ontario Ministry of Energy 2005).

- 9 The National Round Table on the Environment and the Economy's Capital Markets and Sustainability project is advancing Canadian knowledge in this area. For example, studies done for this project explore corporate disclosure and capital markets, compare Canadian and UK pension fund transparency practices, and review the community investment sector in Canada (NRTEE 2005).

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Part 1
Sustainable Production
and Its Context

