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Editorial

Articles

Community Essay

Book Review Perspectives

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EDITORIAL

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Sustainability science: the emerging paradigm and the ecology of cities

Introduction

Humans are a true force of nature and human actions have taken their place alongside the biosphere, lithosphere, hydrosphere, and atmosphere as defining processes shaping the global landscape (Ellis & Haff, 2009). Much like forecasting the weather and trends in the economy, the interactions of humans and complex ecosystems (such as a food web in a tropical rainforest) are fraught with complexity, multiscale interactions, unexpected behaviors, nonlinearities, delayed responses, feedback loops, and extensive temporal-spatial heterogeneity (Levin, 1999; Wu & Marceau, 2002). In light of these circumstances, system modelers embrace spatial heterogeneity as a central attribute of ecological systems and hierarchy as a central structural theme of complexity. Accordingly, they suggest that complex ecosystems have both horizontal and vertical structure. As Sterman (2002) comments,

> [S]ystem dynamics helps us expand the boundaries of our mental models…helps people see themselves as part of a larger system, so that we become aware of and take responsibility for the feedbacks created by our decisions…that shape the world in ways large and small, desired and undesired.

It is simply no longer practical to ignore the interactions between managed and natural systems in sustainable ecosystem management. Effecting a sustainability transition in the Anthropocene, or the Age of Humans (Crutzen, 2006), requires a new degree of transdisciplinary training along with better forecasting of the consequences of human actions (Naveh, 2005).

Why?

Two contexts frame the modern human condition as it affects the world's ecosystems: 1) humankind is not living sustainably, and 2) humans are migrating to urban settings worldwide in accelerating numbers. Few priorities are as relevant or pressing in human-dominated ecosystems as the need for a sustainability transition vetted partly in the reduced ecosystem costs of population growth and urbanization. A successful sustainability transition demands critical advances in basic knowledge, in humankind's social and technological capacity to utilize it, and in the political will to turn that knowledge and know-how into action (NRC, 2002). Moreover, *the transition must consider the dynamics of evolution and the interplay of social, economic, and natural systems, ultimately combined into an integrated, or transdisciplinary, curriculum.* The process goes beyond individual stakeholders and themes–populations, economy, water, food, energy, and climate–to identification of common threads and drivers of systemic change (NRC, 2002). Sustainability science seeks real world solutions to sustainability issues and aims to break down artificial and outdated disciplinary gaps between the natural and social sciences through the creation of new knowledge and its practical application to decision making (Clark & Dickson, 2003; Palmer et al. 2005; Weinstein et al. 2007).

A "New" Paradigm

In their seminal paper, Kates et al. (2001) emphasize that the resolution of competing interests is a central challenge for the sustainability transition. Both Kates et al. (2001) and the U.S. Commission on Ocean Policy (2004) note that it is impossible to maximize all competing interests in a way that will satisfy all stakeholders, or to maintain human-dominated ecosystems at some historic, relatively pristine baseline. The process of integration and the general application of sustainability science to systems research are still in their infancy and fraught with challenges, in addition to those cited above. Clearly, the structure, method, and content of sustainability science must differ fundamentally from most

science as we know it–reductionist methods alone will not be enough; also essential are parallel functions of social learning that incorporate the elements of action, adaptive management, and policy as experiment.[1]

Thus, sustainability science addresses the fundamental character of interactions between nature and society, and society's capacity to guide those interactions along sustainable trajectories (Kates et al. 2001):

> It has become increasingly clear that much [sic] of the workings of the world, and the challenges and opportunities these workings entail for a transition to sustainability lie in the interactions among environmental issues and human activities that have previously been treated as largely separate and distinct…in the next decade we will see research and problem-solving shift in focus from single issues to multiple interacting stresses (NRC, 2002).

The underlying principles of sustainability science contend, moreover, that a sustainable biosphere is not only necessary, but economically feasible, socially just, and ecologically sound (Lubchenco, 1998). With new science as its underpinning, the discipline must be broadened to encompass the overarching question: at multiple scales and over succeeding generations, how can the earth, its ecosystems, and its people interact toward the mutual benefit and sustenance of all? Answers lie not only in sustainability science's transdisciplinary nature, but also in the transfer of new findings to practical uses. The practitioners of technological and economic disciplines must find better ways to design new products and processes that result in less environmental harm. Clearly, the concept is catching on in the "green" wave of new products, infrastructure, energy use, and day-to-day living.

Three challenges confront society's ability to acquire useful knowledge through research for sustainability planning (NRC, 2002). These take the form of tensions among:

- Broadly based versus highly focused research.
- Integrative research that is problem-driven versus research grounded in specialized disciplines.
- The quest for generalizable scientific understanding of sustainability issues versus the need for place-based understanding of environment-society interactions that result in nonsustainable practices.

In addressing these challenges, the National Research Council (NRC) posited three priorities for sustainability science:

- Promoting research that integrates global and local perspectives in a place-based framework for understanding the interactions between environment and society.
- Focusing, at the outset, on a limited set of understudied questions, those that underpin the understanding of those interactions.
- Promoting more efficient use of existing tools and processes that link knowledge and action.

The NRC notes further that the process should bridge the gulf between the detached practice of scholarship and the engaged practice of engineering and management, and ultimately should broaden knowledge of the interplay of environment, economy, and social systems. The core disciplines that will provide the foundation for moving sustainability science forward include a) the biological system that emphasizes the intertwined fates of humanity and the natural resource base–biodiversity, restoration ecology, and conservation biology are essential components; b) the geophysical system that addresses climate and biogeochemical cycling and is grounded in efforts to understand the earth as a system; c) the social system that concerns itself with how human institutions, economic systems, and beliefs shape the interactions between society and the environment, and lastly; d) the technological system that enhances basic technological knowledge, designs, and processes that produce more social goods with less residual environmental damage.

Sustainability science, therefore, seeks real world solutions by breaking down artificial and outdated disciplinary gaps between the natural and social sciences through the creation of new knowledge and its practical application to decision making (Clark & Dickson 2003; Palmer et al. 2005; Weinstein et al. 2007). Above all, the sustainability transition and sustainability science are committed to bridging barriers through a transdisciplinary approach across biophysical, socioeconomic, planning, and design principles (Naveh, 2005). Sustainability science also addresses issue of scale; for example, while planetary circulation and biogeochemical cycling occur globally, sustainable landscapes (especially where humans dominate) and ecosystems are best managed at a regional or local level (Grimm et al. 2000). This message is amplified by the NRC (2002) statement that, "understanding the links between macroscale

[1] See in particular http://sustsci.aaas.org.

and microscale phenomena is one of the great queries of our age in a wide array of sciences. The pursuit of such understanding will also be a central task of sustainability science."

Integrating Sustainability Science into Urban Research

By 2050, approximately 60% of the world's population will live in urban settings; in the United States that percentage is now nearly 80%! This demographic shift has led to regional habitat loss and fragmentation, regional and local climate alteration, depletion of water resources, and degradation of land and water by contaminants. Perhaps more than most human-dominated ecosystems, the urban setting presents a plethora of opportunities to link ecological and social science theories using resource economics concepts (Collins et al. 2000). A realistic understanding of human impacts on ecosystems will necessitate conceptual frameworks that explicitly include humans in the landscape. Such an approach is likely to better inform environmental problem solving (Grimm et al. 2000; Weinstein & Reed, 2005; Weinstein et al. 2007). Obviously, it is the human dimensions that drive political, economic, and cultural decisions that lead to or respond to change in ecological systems.

There are growing opportunities to integrate knowledge of the flows and cycles of critical resources in urban ecosystems with social and governance institutions into a new paradigm for landscape management (Zonneveld, 1989). While urban-rural gradients are complex, multidimensional constructs, the analysis of such systems has become a powerful tool for understanding ecosystems across a wide range of defining variables, stress factors, disturbances, and other drivers. Common themes in urban sustainability science research include questions of hierarchy and scale; how they are related to our ability to understand the dynamics of landscape change, biodiversity, wildlife distribution, and vegetation patterns; and the reciprocal relationships among all of these factors and human activity. Moreover, Pickett & Cadenasso (2006) note that all ecosystems inhabited by humans should be "modeled to include individuals as well as the social aggregations they generate or influence." They suggest further that "it is perfectly reasonable to incorporate such factors and processes into ecosystem models."

Both the Baltimore and Phoenix ecosystem studies, long-term research programs carried out under sponsorship from the National Science Foundation, have provided fertile ground for understanding the ecology of cities and offer a useful framework for extending these efforts into other urban settings. Although it is beyond the scope of this editorial to review the burgeoning literature on the subject, highlighting that emerging conceptual framework will, hopefully, capture the attention and imagination of most scientists, no matter what their current field of practice.

Zipperer et al. (2000) suggested two fundamental approaches to unraveling the dynamics and effective management of urban systems. The first, from an ecosystems perspective, considers the magnitude and control of fluxes of energy, matter, species, and information across landscapes; and the second, from a patch-dynamics perspective, focuses on spatial heterogeneity:

1. Understanding complex ecosystems including cities requires new spatial modeling approaches; among them a wide array of model types: diffusion-reaction, system dynamics, patch (or gap) dynamics, cellular automata, and fractal models (Levin, 1999).
2. Patch dynamics emphasizes spatial and temporal heterogeneity, nonequilibrium properties, and scale dependence, and facilitates the coupling of pattern and process (Wu & Levin, 1997).

Both natural and anthropogenic disturbances are frequently responsible for these processes (Wu & Loucks, 1995). By recognizing that spatial heterogeneity is a central attribute of all ecological systems, that hierarchy is a central structural theme of the architecture of complexity, and that complex ecosystems have both horizontal and vertical structure, hierarchical patch dynamics has become a promising approach to unraveling complexity because it addresses the spatial structure of landscapes; the flow of materials, energy, and information across mosaics/gradients, both as individual architectural components; and the mosaic as a whole. In short, the patch becomes the fundamental structural and functional unit of ecosystems (Wu & Loucks, 1995; Pickett et al. 2000; Wu & David, 2002), and the landscapes thus become spatially nested hierarchies that can be effectively studied as such (Wu & David, 2002).

From a transdisciplinary perspective, the research goals for the Baltimore ecosystem study illustrate the need to build sustainability science into coastal ecosystem management. They are presented here as general questions (Pickett & Cadenasso, 2006):

1. How do the spatial structures of socioeconomic, ecological, and physical features of an urban area relate to one another and how do they change with time?

2. What are the fluxes of energy, matter, human-built capital, and social capital in an urban system; how do they relate to one another; and how do they change over the long term?
3. How can people develop and use an understanding of the metropolis as an ecological system to improve the quality of their environment and to reduce pollution to downstream air, watersheds [and coastal environs]?

In short, what are the institutional arrangements, constraints, and opportunities out there that test our mettle as scientists (natural, social, and economic)? My colleagues and I, members of the International Working Group on Sustainability, have tried to incorporate many of these concepts into our own descriptive approach to researching and managing coastal ecosystems (Weinstein & Reed, 2005; Weinstein et al. 2007). Thus, while the knowledge of nature in cities sets the foundation for addressing ecological processes along the urban gradient, it is not sufficient for understanding how those processes ultimately become a function of the feedback dynamics associated with interactions among social, ecological, and economic drivers.

As noted earlier, a central challenge for the twenty-first century is to address the question: how can the earth, its ecosystems, and its people interact toward the mutual benefit and sustenance of both? The urban megalopolis and its watershed present unique opportunities to grow the sustainability science agenda to encompass the following issues:

- With the anticipated doubling to tripling of urban populations worldwide in this century, how can we accommodate new infrastructure that is at once energy efficient, less material intensive, and smaller regarding the ecological footprint?
- How do we choose where and how much new infrastructure to build while understanding the potential environmental offsets in terms of reduced carrying capacity, altered thresholds, and stresses that may shift urban-industrial ecosystems to new less-desirable steady states? A critical challenge concerns the emerging science of restoration ecology and our ability to mitigate (restore/rehabilitate) system functions as the human populace expands.

The NRC (2002) called for informed dialogue on goals for a sustainability transition, a dialogue that is necessary if societies are to adopt a measure of responsibility for their choices. Such a transition should seek to purposefully target rather than passively navigate the currents of demographic, economic, and environmental change. Research-informed outreach will also be a key to success. Forward-looking institutional structures will be needed to connect local end users–corporations, households, land-use planning commissions, governments, and regional research centers–into a regional management system. From a life-support system perspective, new knowledge and tools are required in three areas: improved understanding of ecosystem processes (e.g., population dynamics, interspecific interactions, and spatial-temporal variability), effective ecosystem management at the landscape scale, and monitoring programs with the statistical power to detect change against background variability.

Grounded in transdisciplinarity, sustainability science will create the new knowledge required to address the paradox of the dual mandate and the tensions associated with competing uses.[2] Two other ingredients are also essential: (1) social learning manifested as the slow, interactive accumulation of scientific knowledge, technical capacity, management institutions, and public concern over extended periods (generations) and (2) new methodologies that generate semiquantitative models of qualitative data, building upon the lessons of case studies, and extracting "inverse" approaches that work backwards for undesirable consequences to identify pathways that avoid such outcomes (Berkes et al. 2008).

Thus, while ecological considerations and natural capital are essential, the ultimate success of sustainability science rests on social and cultural capital and is therefore a fundamental human trait. We must do a better job of managing ourselves before we can effectively manage the earth and its resources.

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[2] Whereas complexity, interdependence, high levels of uncertainty, unpredictability, and dynamism characterize natural systems–traits that prevent competitive dominance by any one species–human-dominated systems require predictability and stability to ensure uninterrupted provision of resources for human use. The paradox of the dual mandate arises from the need to reconcile society's desire to preserve, restore, and rehabilitate natural ecosystems while at the same time ensuring the provision of reliable, predictable, and stable supplies of goods and services at a time of escalating demand (Roe & van Eeten, 2001).

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ARTICLE

An adaptive indicator framework for monitoring regional sustainable development: a case study of the INSURE project in Limburg, The Netherlands

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Indicators by themselves tell us little about how well a system is progressing in relation to the goal of sustainability. Especially at the regional level, existing indicator frameworks do not typically permit the inclusion of relevant region-specific information. Furthermore, they do not provide comprehensive information on overall system sustainability. The real challenge is not to identify indicators–there are hundreds of good lists–but to seek out the best way to put all of them to work. The INSURE project, carried out in four case-study regions in Europe (including the Limburg region of The Netherlands), attempted to develop an adaptive indicator framework for integrated monitoring of sustainable development. During the project, it became increasingly clear that indicators are not only more meaningful when viewed within the context of the whole system, but also that science and policy play different, but complementary, roles. This article discusses the challenges and the lessons learned during the Limburg project.

KEYWORDS: sustainable development, macro-scale indicators, regional planning, stakeholders, public policy, sociopolitical aspects

Introduction

Because the results of sustainable development efforts often only become visible after a long period of time, it is necessary to monitor the implementation of processes as they unfold. Continuous appraisal helps to make progress visible and to steer processes in the appropriate direction. However, a meaningful assessment of sustainable development encounters problems regarding the choice of indicators and the integration and interpretation of information. In general, indicators by themselves tell us little about how well a system is doing in relation to the goal of sustainability or how it will respond to certain policy initiatives. There is a vast range of published criteria for measuring and evaluating sustainable development, but most of them are geared to the global or national level (Bühler-Natour & Herzog, 1999; Graymore et al. 2008). At the national level, indicator sets include the framework of the United Nations Commission for Sustainable Development (UNCSD) and the European Union (EU) sustainable development indicator framework (European Commission, 2005; United Nations, 2007). Sustainability indicators have been developed for a variety of purposes, such as policy reform, socioeconomic assessment of rural areas, benchmarking, justification of public expenditures, support for land stewardship, and intergenerational equity (King et al. 2000). They have been applied at different geographic scales, such as countries, regions, and cities (Graymore et al. 2008). However, several authors state that measuring sustainable development at the national level, or with national-level data, might fail to capture critical issues at the regional level (Bühler-Natour & Herzog, 1999; Herrera-Ulloa et al. 2003; Reed et al. 2006). Graymore et al. (2008) show that various methods reported to be useful at different levels of spatial detail—including the regional—are not completely effective at the regional scale due to data limitations and a top-down definition of sustainable development.

In terms of geographic scale, regions have an optimal size for successfully implementing sustainable development: small enough to be of direct interest to residents and large enough to possess critical mass for creative solutions (Zilahy & Huisingh, 2009). A region should be seen here as an area smaller than a nation that has an identity demarcated by boundaries (an administrative entity) or identified by relatively homogeneous economic, social, or landscape characteristics. In this sense, a region can cross borders (e.g., the Euroregion Meuse-Rhine includes Belgian, Dutch, and German provinces and is an area with a shared history and similar economic interests). Graymore et al. (2008) state that the regional scale is:

> [T]he most appropriate for natural resource management and for progressing sustainability, because it is at this scale where ecological functioning and human activities most intensely interact and where a balance between the two is critical to studying and resolving natural resource and sustainability issues. It is also at this scale where the most difference can be made by decision-making and community choice.

Furthermore, Graymore et al. (2008) contend that the regional level provides the greatest opportunity for local governments to work together with their constituent communities toward sustainable development. Pointing out that values may differ across regions, Stevenson & Ball (1998) propose an approach to measuring the sustainability of materials that allows for this variability instead of applying generic standards. McManus (2008) contends that a regional unit of analysis incorporates processes that go beyond the regional level. For example, in the case of the Upper Hunter region of Australia, the coal-mining, horse, and wine industries all affect regional sustainability, but are also part of national and global processes. Regional assessments should incorporate such considerations, recognizing that "regional sustainable development is a relative concept and is a process of becoming" (McManus, 2008). A danger of selecting indicators without taking into account the context or a common vision is that they may not provide useful insights about sustainability.

Numerous methods for identifying indicators exist, as well as a variety of criteria for selecting indicators. Indicators are often identified by means of participatory processes (e.g., Bell & Morse, 2004; Mickwitz & Melanen, 2009), and this process is often combined with a literature review of available indicator sets (Bühler-Natour & Herzog, 1999; Kelly & Moles, 2002; Wallis, 2006; Putzhuber & Hasenauer, 2010). It is also common for researchers themselves to select the relevant indicators (Bouman et al. 1999; Herrera-Ulloa et al. 2003; Viglizzo et al. 2003). Criteria used to decide on indicators include objectivity and ease of use (Reed et al. 2006), the Bellagio Principles[1] (Ramos & Caeiro, 2009), availability of time series, and inclusion in official government-formulated sustainable development indicator (SDI) lists (Herrera-Ulloa et al. 2003). Further criteria are simplicity, scope, quantification, sensitivity, and timeliness (Kelly & Moles, 2002). Spangenberg (2002) suggests that indicators should show the status of a domain, as well as interlinkages among domains. Another aspect of indicators is the weight factor that is assigned to them. Again, a multitude of approaches exists. Some authors consider all indicators of equal importance in their sustainability reports (European Commission, 2005; 2007; Provincie Limburg (België), 2006; IISD & JRC, 2009), while other researchers use participatory processes for ranking the indicators to identify the most important ones for a given region (Kelly & Moles, 2002; Mickwitz & Melanen, 2009). It is also common to use regression analysis (Putzhuber & Hasenauer, 2010) to seek out weakly correlated indicators (Herrera-Ulloa et al. 2003) or to rely on coefficient-generating tools and models (Bouman et al. 1999).

In summary, there are different ways to identify indicators, to determine selection criteria, and to assess relative importance. Moreover, measuring sustainable development is not only an objective issue, but, unavoidably, a political one. Taking into account the diverse meanings of sustainable development and its specific interpretations in various regions, it is often difficult to identify indicators for carrying out sustainability assessments. Indeed, Reed et al. (2006) observe that indicator selection is just one step in a sequence that starts with identification of the context and constituent visions and strategies.

This article discusses an adaptive indicator framework for measuring regional sustainable development. It is adaptive in the sense that it allows for the inclusion of regional characteristics and different methods for selecting indicators. This so-called INSURE method, developed to find meaningful indicators at the regional level, was implemented in four case-study regions: Antalya (Turkey), Limburg (The Netherlands), Lombardy (Italy), and Pardubice (Czech Republic).[2] Instead of just measuring the "symptoms of unsustainability" through individual sustainable development indicators, INSURE sought to get to the "causes" with a more fundamental understanding of the region as a system. During the project it became increasingly apparent that indicators become more meaningful with this approach. The real challenge is not to identify indicators, but to look for the optimal way to combine them to provide a picture of regional sustainable development (cf. Grosskurth & Rotmans, 2005; Wiek & Binder, 2005).

[1] The Bellagio Principles serve as guidelines for the entire assessment process, including the choice and design of indicators, their interpretation, and the communication of results. They are interrelated and should be applied as a complete set and are intended to start and improve assessment activities of community groups, nongovernmental organizations, corporations, national governments, and international institutions. See http://www.iisd.org/measure/principles/progress/bellagio_full.asp.

[2] Details on INSURE (Flexible Framework for Indicators for Sustainability in Regions, Using System Dynamics Modelling) are at http://www.icis.unimaas.nl/projects/insure. The research program was active between 2004 and 2007.

The flexible framework inherent in INSURE puts the indicators into perspective with the aim of coming to a regional assessment. This article discusses the challenges we faced (some of which remain unresolved) and the different roles and actors involved in carrying out this task.

The next section discusses the normative aspects of measuring sustainable development and the roles of policy makers and scientists in the steps of the monitoring process (defining the perspective on sustainable development is an especially normative issue). The role of indicator frameworks as an expression of the political view on sustainable development is then discussed. The importance of indicator frameworks and the roles of policy and science are further explored in the sustainability assessment of the Limburg region in The Netherlands. Based on the outcomes, several challenges for monitoring are discussed and conclusions are drawn that give some insight into assessing sustainable development at the regional level.

Measuring Sustainable Development: A Normative Issue

The search for effective sustainability indicators continues to be framed primarily as a technical or scientific problem rather than a political challenge. Although science clearly is needed to develop understanding of the underlying systems, states, and processes that indicators reflect, the role of scientists in *selecting* policy-relevant indicators is less clear. McCool & Stankey (2004) observe that the actors involved in identifying indicators are making choices at the interface of science and policy. These authors also note that indicators are often selected based on our *ability* to measure a particular phenomenon (a technical issue) instead of on the *need* to measure it (a normative issue).

The field of sustainability science generally recognizes that scientists and policy makers are part of a heterogeneous network that has to manage different kinds of knowledge (cf. Reitan, 2005; Martens, 2006; IHDP, 2008; Regeer et al. 2009). The different styles of knowledge creation in these domains must be integrated to bridge the gaps among science, practice, and policy. With respect to indicators, we also encounter a need for knowledge integration. The social and normative question "what is to be sustained" should always precede the search for indicators (van Zeijl-Rozema et al. 2008). Without societal agreement on this point, it is impossible to identify relevant and valid indicators.

McCool & Stankey (2004) and Reed et al. (2006) contend that establishing sustainability goals should be the starting point for measuring sustainable development. However, when scientists intervene on what should be sustained, they move into the realm of decision making. As scientists are usually not elected through democratic processes, they should be extremely cautious about setting sustainability goals and standards. Sustainability should ideally be determined by what the community values within the broad framework of the triple bottom line (people, planet, profit) or the Brundtland definition (Stevenson & Ball, 1998; Reed et al. 2006; Wallis, 2006). Tools to assess progress must be developed within the context of the local landscape (Wallis, 2006). Sustainable development is not a single, well-defined concept; rather, various positions and perspectives exist. Whichever view is propagated, it entails a normative choice (van Zeijl-Rozema et al. 2008).

After establishing sustainability goals, the next step in the process of measuring sustainable development is the selection of appropriate indicators. If the goals are clear, experts can typically find indicators that show progress toward them. However, if the goals are ambiguous, the selection of indicators will reflect the selectors' worldview and emphasize certain areas while neglecting others, regardless of policy priorities.

The last step is the interpretation of results. Here, again, much depends on the setting of goals, as well as on the criteria. Without criteria it becomes extremely difficult to judge whether a development is sustainable or unsustainable. A distinction is therefore evident between the roles of science, on the one hand, and policy and society, on the other hand. A linkage between the two is required and the question becomes how to realize it.

Reed et al. (2006) distinguish four steps for developing and applying sustainability indicators. The corresponding linkages to science and policy, as we see it, are mentioned in brackets:

1. Determine the context; identify the key stakeholders and define the system or area relevant to the problem being studied [science/policy].
2. Establish sustainability goals and strategies [policy].
3. Identify, evaluate, and select indicators (where evaluation refers not to interpretation of the data, but rather to assessment of the representativeness of the indicators) [science].
4. Collect the data to monitor progress [science/policy].

McCool & Stankey (2004) indicate that interaction and participation of actors from science and society—and thus coproduction of knowledge—are essential for regional assessments of sustainable development. They observe that scientists have impor-

tant roles to play, such as clarified problem framing, system description, system measurement, display of outcomes, and interpretation of implications and options. The public and policy makers are responsible for providing clear sustainability goals to support and enforce monitoring, to evaluate monitoring data, and to implement policies leading to sustainability. In their words:

> [T]he respective roles are interdependent, essential, and mutually informing, and the processes used in implementing indicator information are iterative, adaptive, and ongoing, incorporating new information as society learns how to better measure and monitor important system information (McCool & Stankey, 2004).

If we combine the two frameworks, the relationships depicted in Figure 1 emerge. In this illustration, the dark blue signifies the role of policy and the light orange the role of science. The rectangles, connected by arrows, denote the steps in the process of assessing sustainable development. For each step, the roles of actors from policy and science are indicated.

It merits noting that the various roles are not strictly separated, but are instead fluid. To conduct a proper monitoring exercise, it is important to be aware of the roles of different actors, the steps in the process, and the degree of complementarity among them. Such an exercise is a complex affair that requires the knowledge and involvement of numerous stakeholders throughout the process

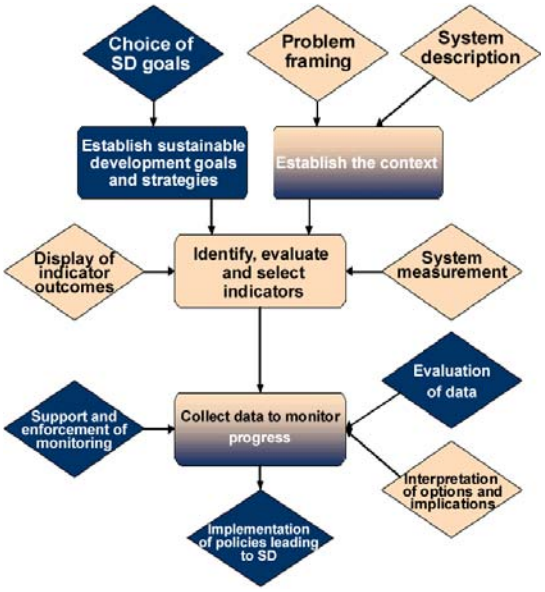

Figure 1 The role of policy and science in the various stages of monitoring sustainable development (policy in dark blue, science in light orange, steps in the process in rectangles, roles of actors in diamonds).

Using Indicator Frameworks

Numerous organizations such as the EU and the UNCSD have developed indicator frameworks on sustainable development, each reflecting the key issues for a particular geographic area. For instance, the EU indicator framework is set up to monitor the implementation of the EU Sustainable Development Strategy at the national level (European Commission, 2005). The UNCSD Indicators of Sustainable Development aim to monitor the national implementation of Agenda 21, the Johannesburg Plan of Implementation, and the Millennium Development Goals (United Nations, 2007). In other words, an indicator framework generally addresses a certain institutional perspective on sustainable development and a set of political priorities for action and focuses on a certain spatial scale. Each framework is an expression of a "political agenda that identifies the priority elements of a specific sustainability policy" (INSURE, 2007). Moreover, indicator frameworks are not always transferable to other parts of the world, to other perspectives on sustainable development, or to different scale levels. It is therefore important to be aware of the purpose for which a specific indicator framework is being designed.

In the INSURE project, we used the EU indicator framework as a political expression of sustainable development. The aim in this case was to develop a method that included regional characteristics in an indicator framework in such a way that the relative importance of each indicator within the regional system was made visible. This approach permitted a comprehensive picture of the region's dynamics, including its strengths and weaknesses. The EU framework provided the necessary context and goals on sustainable development. Because we used this particular scheme, it is worthwhile to briefly highlight its history and focus.

To appreciate the emergence of the EU indicator framework, we need to go back to the introduction of sustainable development as an explicit objective of the European Community as it was expressed in the Single European Act of 1987. Over the subsequent two decades, many regional meetings have taken place to foster a political commitment toward sustainability. At the Gothenburg Summit in 2001, EU member states agreed that the economic, social, and environmental effects of all policies should be examined in a coordinated way and taken into account in decision making. The European Council identified ten priority areas for sustainable development as general guidance for policy measurement and develop-

ment.[3] This set of concerns is reflected in the EU sustainable development indicator scheme: (1) economic development; (2) poverty and social exclusion; (3) aging society; (4) public health; (5) climate change and energy; (6) production and consumption patterns; (7) management of natural resources; (8) transportation; (9) good governance; and (10) global partnerships (European Commission, 2004).

The INSURE Method: Lessons from Limburg

As mentioned above, the main goal of the INSURE project was to find region-specific indicators and to combine them in such a way that they could provide an integrated view of regional sustainability. We used the EU indicator framework to provide the political context and vision on sustainable development and to establish a basis for comparison for four case studies. However, the EU framework is structured in a hierarchical way with themes, subthemes, headline indicators, and so forth. We wanted to obtain a meaningful picture of sustainability at the regional level, with indicators characteristic of the region. It was obvious that the EU framework would not always match regional features. This situation not only implied the use of regionally collected data for the predefined indicators, it also meant using different indicators altogether for the themes in the framework.

One could reasonably ask why we went through this difficult maneuver to measure regional sustainable development. Why not develop a customized framework for each case study? First, comparability among case studies would have been impossible with different frameworks incorporating inconsistent priorities and goals for each region. Second, the point was not to design a framework for each region, but to provide a generic approach for measuring sustainable development without following the standard approach of predefining a universal indicator set. Finally, the aim was not to design the context and goals for each region, but to show that defining them is an important step for measuring sustainable development. The project operationalized the context and goal-setting step by using an existing political expression of sustainable development.

We next conducted a qualitative systems analysis (QSA) of the region to establish the context. A broad regional picture was thus obtained using the EU framework as a filter for detailed analysis. It pointed to those areas that were important for the EU's sustainability goals. It should be noted that a different framework could have conceivably focused on other elements of the regional system. To see how this situation could have occurred, just imagine two different perspectives on sustainable development: an ecological perspective that places great emphasis on regional carrying capacity and a well-being perspective that stresses social health. Within each view, different parts of the regional system would become more or less important.

For those areas highlighted within the region, indicators were sought. A second requirement was that the indicator needed to provide insight into the state of an *influential* element in the regional analysis. Influential means here an element that has a notable impact within the system or, in other words, that is an important driving force. For technical details on determining influence, readers are encouraged to consult the INSURE website. The reason behind this second requirement was to enable us to evaluate the indicators in relation to each other. The influence within the system was used to weight the indicators so that we could judge, for example, the relative importance of congestion in relation to decreasing agricultural land use (Figure 2).

Essential for the method described here is the interpretation of an indicator *within the system*. It is not uncommon to encounter long lists of indicators that tell us nothing about their respective roles and functions in sustainable development (Provincie Limburg, 2005a; Provincie Limburg (België), 2006). For example, Eurostat, the statistical bureau of the European Commission, struggled in its 2007 progress report with how to derive an overall picture of progress toward sustainable development using eleven headline indicators (European Commission, 2007).[4] In another case, the UNCSD guidelines on indicators recommended using simple symbols suggesting forward or backward movement on each element to communicate the direction of progress on sustainable development in a particular country (United Nations, 2007). However, neither the European Commission nor the United Nations discusses how individual indicator values might provide a

[3] The European Council comprises the heads of state or government of the member states belonging to the European Union and the President of the Commission. It came into being in 1974 and was given formal status by the Single European Act. Its members are assisted by the respective ministers for foreign affairs and by a member of the Commission. Since 2000, in accordance with the Lisbon Strategy, the European Council addresses economic, social, and environmental issues (see http://europa.eu/european-council/index_en.htm).

[4] The European Commission is the EU's executive body. It represents and upholds the interests of Europe as a whole, drafts proposals for new European laws, and manages the day-to-day business of implementing EU policies and spending EU funds. The Commission also makes sure that everyone abides by European treaties and laws. See http://europa.eu/abc/panorama/howorganised/index_en.htm.

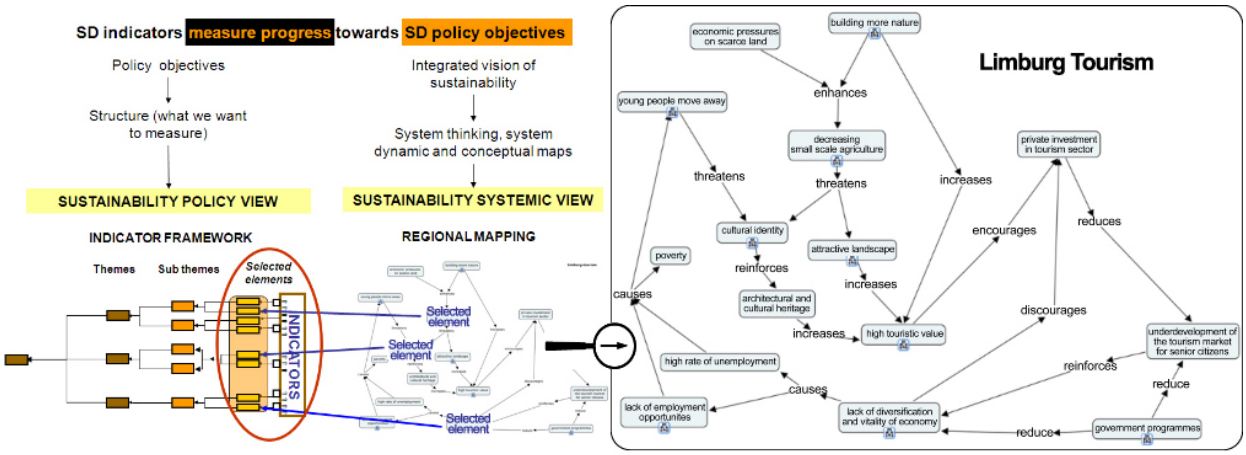

Figure 2 Combination of the sustainability policy view (as expressed in an indicator framework) with the sustainability systemic view (represented by a system map of the region showing relations between regional elements) (adapted from INSURE, 2007).

comprehensive picture of sustainable development that takes into account the varying importance and systemic impacts of each indicator within the system. By contrast, the INSURE project demonstrated the relative importance of an indicator in relation to other indicators and how it contributed (or not) to sustainable development.

The value of the indicator tells us something about an element's state or trend. The importance of the indicator gives it a certain weight in the regional sustainability assessment. We aggregated this information into a dashboard view, where the color signals the indicator's state and the width of the wedge represents its weight. Moving from the outside to the center, the values are then aggregated into subthemes and then themes, with an overall impression of sustainable development in the center (Figure 3). The lower aggregation levels in the outer ring, as well as the qualitative systems analysis, are important for identifying a system's sustainability problems.

As an example, we interpret the results of a discourse analysis in Limburg with the EU framework as the definition of sustainable development (Figure 3). A striking result of this integrated sustainability assessment is that the region seems to be doing quite well with respect to economic development. Even a very negative value for the land-prices element is smoothed out by other positive and influential elements at the next level. This observation appears to contradict most reports that contend that economic development is lagging in Limburg (e.g., Provincie Limburg 2005b; 2006; 2007a). We can understand this apparent contradiction in the following terms: the dashboard shows regional trends, but does not indicate how far away the current situation is from the sustainability goals. The economic development trend in Limburg was strong at the time of the analysis (2004–2007) and therefore was represented positively in the dashboard, but regional economic development is still far from its potential.

In Limburg, poverty and social exclusion are decreasing and the aging of society, as well as public health, shows a positive to neutral trend, meaning that pensions are sufficient, poverty is under control, and health care is adequate. Production and consumption patterns are not harming sustainable development. However, attention should be given to the effects of the transportation sector on public health. More transportation will lead to more congestion with negative consequences on air quality and people's health. More traffic will also cause more health risks due to accidents. In addition, the decrease in Limburg's agricultural area is a negative development, especially for the southern part of the province, because it not only affects the production and consumption of regional products, but also changes the landscape. The small-scale landscape is a product of past and current agricultural activities. The resulting landscape, with hedgerows and attractive farms, contributes to the region's value as a tourist destination. Under the theme "management of natural resources," we observe negative trends. A combination of economic pressure on scarce land, declining agricultural subsidies, demand for more roads and houses, and land scarcity influences fresh water resources and land use. Although transportation is a growing sector, it is slightly negative due to increasing congestion. The overall value for Limburg shows moderately positive progress toward European sustainable development goals.

From this assessment we learn that at higher levels of aggregation in the dashboard (i.e., the rings closer to the center, representing the subtheme or theme level) the prevailing development trend is gen-

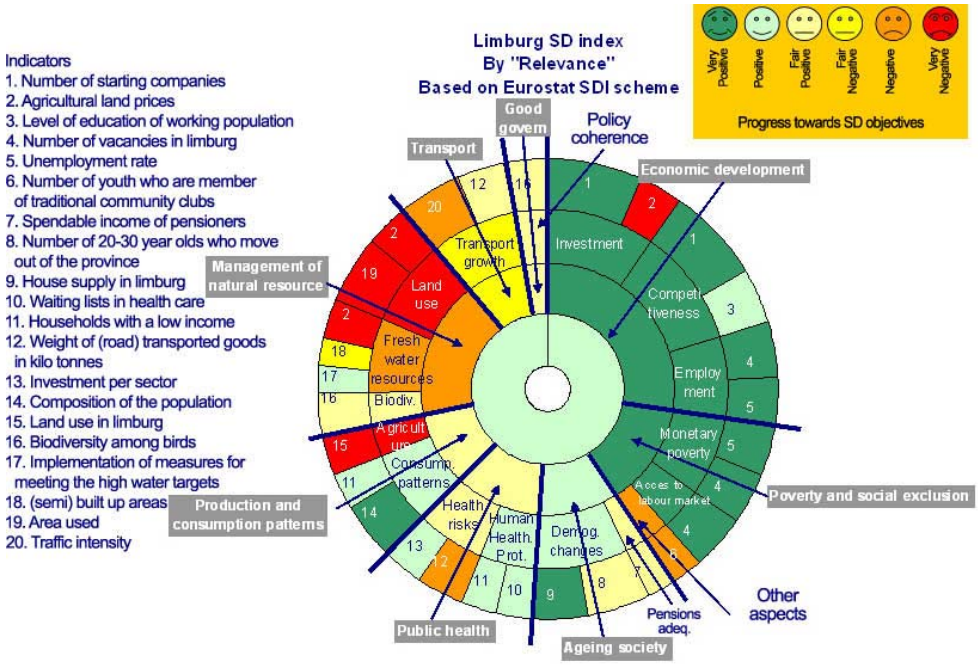

Figure 3 The dashboard overview of sustainable development in Limburg for the EU-SDI framework.

erally positive. However, policy makers should devote attention to the areas highlighted in the outer ring where there are signals of specific problems. A system analysis of the region can provide further insight into these underlying dynamics. In this case, the framework clearly focuses on certain issues considered problematic for sustainable development within the European context, such as an aging society or poverty and social exclusion.

A Regional Framework

The previous section described how Limburg is doing with respect to sustainable development from an EU perspective. However, some important elements from the general regional systems analysis could not be accommodated in the EU framework (e.g., transboundary drug dealers, cultural identity, and architectural and cultural heritage). This situation means that certain facets were not considered important for that specific (political) view on sustainable development, although they were important for the region (based on the QSA results). The EU priorities were not necessarily regional priorities. Similarly, some themes of the EU indicator framework were not relevant for Limburg and were disregarded. For instance, the condition of the marine environment did not apply as Limburg is landlocked. This observation highlights why, in terms of some criteria, the EU framework is inappropriate for conducting a sustainability assessment for the region.

Accordingly, the regional administration wanted to conduct a sustainability assessment from a perspective that would enable it to fulfill a biennial monitoring requirement. An expert group consisting of provincial administration staff was asked to conduct an assessment using the INSURE method. Completing this task required the use of a meaningful indicator framework that could be adapted to a *regional* scale and that was made or adapted specifically for Limburg. A regional framework can be a tool to follow up on progress toward the current political agenda on regional sustainability or a set of particular regional concerns. However, comparability among the development of different regions dramatically decreases when a regional framework is used because every region introduces into the framework its own idiosyncratic priorities and key issues (INSURE, 2007).

A regional framework of sustainability indicators did not exist for Limburg, so one had to be designed. When we started developing this framework within the context of the biennial exercise of monitoring the status of the province, the Limburgmonitor (Provincie Limburg, 2007b), it became clear that policy makers lacked a long-term vision on regional sustainable development. On the basis of various policy documents, it was possible at best to assemble a partial vision. According to the provincial administration:

> [S]ustainable development has in theory five dimensions: ecological, economic, socio-ocultural aspects, long-term effects and effects elsewhere. Furthermore…development must take place in such a way that the value of each form of capital increases and that the increase of one type of capital does not reduce the value of the other capitals (Provincie Limburg, 2005c) (translation by authors).

A self-evaluation by the province of its sustainability policy (2005–2007) stated that measurable goals and related indicators had not been identified because the program emerged only during the government period of 2003–2007. Therefore, regional officials could not draw any conclusions on the policy's success (Provincie Limburg, 2007c). The current coalition agreement, a document that describes the overall political priorities for the period 2007–2011, explicitly recognizes the first three domains cited above (i.e., ecology, economy, and society) and their interconnectedness and regards sustainable development as an important pathway (Provincie Limburg, 2007a). However, sustainable development is not made concrete and is not supported by clear goals.

As a consequence, the expert group working on regional monitoring did not want to interfere with what its members saw as a role for policy makers by setting their own priorities for sustainable development in Limburg. Therefore, the regional framework remained rather indistinct and was based simply on the three pillars of sustainable development: society, economy, and ecology. Furthermore, the absence of sustainability goals and criteria for interpretation became a major barrier to conducting a successful sustainability assessment. This problem could not be overcome by using an expert group that had no political mandate for defining sustainable development in this regional context because it was neither representative of the population nor an elected body with delegated powers from the residents of Limburg. Due to the absence of policy-making input into the process, problems arose at several stages (see Figure 1).

This project made clear that at all stages of measuring sustainable development, the involvement and cooperation of relevant policy makers and technical experts is essential. With hindsight, we must admit that enhanced cooperation among these participants from the beginning would likely have led to a more meaningful assessment.

Discussion

The previous sections have demonstrated the importance of linking science and technical expertise with policy in integrated sustainability assessment and the problems that arise if these roles are not effectively fulfilled. However, several questions remain. What recourse is there when a vision of sustainable development is not available? Is an indicator framework truly an expression of a political vision of sustainable development? Can a systemic analysis be regarded as neutral, or is it also an expression of a certain vision? And to what extent should stakeholders be involved? The following sections consider each of these questions in turn.

Missing Vision

Without a vision, an effective statement on sustainable development is hard to articulate. To say something meaningful on this subject with respect to Limburg, it is first necessary for the government or other representative body to provide such a viewpoint. Once the goals have been made explicit, it is possible to start to measure the distance that needs to be travelled. However, as Reed et al. (2006) mention, most often indicator exercises start with the identification of indicators. For Limburg, the EU sustainable indicator framework provided sustainability goals, but regional sustainable development goals were lacking. With good reason, the experts did not want to take on the role of policy makers in setting priorities for the region with respect to sustainable development. We therefore employed a rather simple, indistinct vision of sustainable development, the three-pillar approach, which is so common and uncontroversial that the expert group deemed everyone could live with it. But when deciding on the logic of what was advantageous or disadvantageous for sustainable development, we ran into problems. The three-pillar approach is so general that it is open to multiple interpretations. As a result, we had difficulty discerning a regionally appropriate set of indicators, demonstrating that a sustainable development vision and goals are extremely important.

Neutral Indicator Framework?

In our research, we have used the EU indicator framework of sustainable development as an expression of a European vision of sustainable development. But is this projection really a policy-based viewpoint, or rather a framework conceived by experts based on their ideas of sustainable development? If we read McCool & Stankey (2004) carefully, their stance is that frequently the search for indicators is an *ad hoc* process, hardly related to any framework. Therefore, when using an existing indi-

cator framework, it is legitimate to ask who created it and whether policy makers have endorsed it. If it has received such validation, we can assume that it indeed fits policy makers' contemporary ideas of sustainability. In the case of the EU, the European Commission has adopted this framework.[5] Steinbuka & Wolff (2007) state that

> [T]he list of [sustainable development] indicators itself is not defined, although it is foreseen that a limited set of indicators could be adopted by the European Council by the end of 2007. This solution was preferred by most stakeholders, as it avoids freezing a list of indicators, and allows more flexibility in its improvement and development over time.

As official EU monitoring reports using this framework appear regularly, we can assume some kind of agreement that it provides an appropriate way to assess sustainable development that is in line with EU policy objectives. However, we can also think of scenarios where policy makers have commandeered scientists and other experts to build indicator frameworks and have simultaneously delegated to them the role of defining a vision of sustainable development. We have personally fielded comments that, as scientists or other experts, we should be able to define sustainable development. However, if we review existing literature, it is clear that numerous definitions exist (cf. Parris & Kates, 2003; Robinson, 2004; Burger, 2006; Sneddon et al. 2006).

It is therefore safe to say that sustainable development is a normative concept and not an issue that can be defined by science (van Zeijl-Rozema et al. 2008). Science can help in formulating the vision by showing how certain ideas might be in conflict or by formulating scenarios of possible developments. However, it is up to society, represented by elected politicians and stakeholder groups, to decide on a broad vision of sustainable development and the sustainability of the various pathways. Of course, scientists can provide theoretical models and empirically sound methodologies. In addition, scientists have vital roles to play in supplying intellectual and conceptual frameworks along with critical and analytical perspectives. They can also offer leadership in partnerships as independent facilitators and mediators; assure transparency, credibility, and robustness to sustainable development processes; provide technical expertise; supply knowledge about data sources and their use; and afford access to international networks (Mickwitz & Melanen, 2009; Ramos, 2009; Zilahy & Huisingh, 2009; Zilahy et al. 2009).

Systemic Analysis and Vision on Sustainable Development?

We also inquire about the extent to which a systemic analysis incorporates a hidden vision of sustainable development. The description used for Limburg was formulated in two different ways: through a discourse analysis and by means of an expert group. Each mode resulted in a different description. This variation does not pose a problem if there is clear acknowledgement which group described the system and an understanding of possible biases. For instance, the discourse analysis was based on policy documents so the prevailing political view will be reflected in the system description. The expert group was restricted to staff of the provincial administration. Although this was a multisector group, it was not a multistakeholder assemblage of people. The knowledge and worldviews of the participants determined the system description and therefore gave shape to the systems analysis. The analysis will reflect their ideas about what facilitates sustainable development and what obstructs it. However, ensuring the participation of a multidisciplinary team, preferably from different stakeholder groups (e.g., state, market, civil society), will help to form a general idea of the system. A typical political view, in contrast, will pinpoint several areas for action and leave out others. In conclusion, a systemic analysis is by no means objective, but it forms an impression of a system at a certain scale.

Stakeholder Involvement

As was mentioned earlier, sustainable development monitors should include representatives of state, market, and civil society. The composition of these stakeholder groups might differ at various stages in the process because different roles have to be fulfilled at each phase (Figure 1). An essential aspect of the participation process is that stakeholders view their involvement as making a difference because otherwise there is no incentive for them to participate (Pirk, 2002). It is also essential to clarify from the beginning what issues are under consideration, who will make the final decisions, and why and how stakeholders are involved (National Marine Protected Areas Center, 2004). In the INSURE project, we were developing a method and finding our way in an experimental setting. In such a process, stakeholders might feel lost or lose interest, as we encountered at an earlier stage with staff at the provincial administration of Limburg. With the insights gained during this project and experience acquired deploying this method, we would likely be able to organize a more

[5] See http://epp.eurostat.ec.europa.eu/portal/page/portal/sdi/introduction.

meaningful participatory monitoring process that follows more closely the guidance of Figure 1.

Conclusion

The measurement of regional sustainable development requires several elements: a capacity for flexibility that includes a set of region-specific characteristics, a proper system description, and a vision of sustainable development that determines regional priorities. Once these prerequisites are in place, it becomes possible to assess regional sustainability. From this study, we can conclude that a systems analysis from a sustainability perspective is different from an indicator framework that points at political priorities for sustainable development. However, it is necessary to draw on the systemic view to determine relationships among indicators and their relative importance in the system. It is also important to incorporate the political view to provide the context for deciding what is to be measured and how it should be interpreted.

Based on the results of the Limburg case study, we advance six summary conclusions. First, it is important to link science and policy throughout the whole assessment process. Scientists and policy makers have different roles to play and they contribute different insights (see Figure 1). An assessment carried out by only one group will lead to problems. In the case of an exclusive scientists/experts-run assessment, the normative aspect and social representativeness of sustainable development will be understated. In a policy maker/society-run assessment the transparency, credibility, and robustness of methods and data collection might not be adequately safeguarded (McCool & Stankey, 2004).

Second, the leader of the assessment should always deploy a multidisciplinary team, preferably from different stakeholder groups (e.g., state, market, civil society) to formulate a general overview of the system. These three major groups play different roles within the region and are needed to design general understanding of sustainability and the regional dynamics. The composition of the team might have to change at various points in the overall process.

Third, the organizers should make explicit a sustainable development vision for the assessment. Until agreement is reached on what it is that should be sustained–by government or, ideally, by participation of (representatives of) the region's citizenry–it is impossible to identify relevant and valid indicators. In the absence of structures to establish such a vision, the preparation of a satisfactory assessment becomes extremely difficult.

Fourth, the sustainable development filter, or perspective, used to analyze data has a large impact on the results of the assessment. Related to this point, it is vital to use an indicator framework suited to the purposes of the assessment, to understand what the indicator framework measures, and to be aware of the sustainability perspective used, as this will lead to different priorities for measurement and thus alter results.

Fifth, it is important to relate indicator results to sustainability goals and to ensure that the results are interpreted within the context of the system. An indicator just indicates. An indicator becomes meaningful only when it is seen in the light of a norm, a threshold, or a criterion for analysis. But even under these circumstances, an indicator in isolation does not provide information about sustainability. It is only by relating a particular indicator to other measures and evaluating its importance within the system that we can make a meaningful sustainability assessment.

Finally, when conducting an assessment decision makers should give attention to negative results even if the overall picture is positive. The dashboard view demonstrates how a positive trend at a higher aggregation level could hide negative trends at lower levels. These are signals of underlying sustainability problems and deserve attention. Furthermore, it should be kept in mind that the dashboard shows trends, not the divergence between the current situation and the desired situation. It would be better to show this discrepancy. However, the desired future is largely undefined in the cases of both the EU and the regions, which means only the current situation can be shown.

The INSURE project sought to design a generic framework for determining the sustainability of a region while allowing flexibility to include regional characteristics. The work done in Limburg demonstrates that scientists/experts and policy makers can feasibly be involved in the process. Furthermore, to make a meaningful sustainability assessment it is crucial to create links between the political/social sustainable development vision and the scientific understanding.

Acknowledgement

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ARTICLE

Green local governments in Florida: assessment of sustainability performance

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The sustainability performance of local governments that adopted the Florida Green Building Coalition's Green Local Government standard was evaluated using a web-based review and survey of 26 local governments within the context of the Three Es of environment, equity, and economic development. The results indicate that while many local governments exhibit a broad commitment to sustainability as evidenced by the inclusion of sustainability in formal documents, such efforts are not present across all government functions or departments. In addition, while local issues are often addressed, interrelated sustainability goals of equity and economic development are not clearly articulated. Most local governments in the state instead tend to focus on environmental protection through initiatives such as storm-water management improvements. Nevertheless, the use of specific benchmarking tools by Florida governments can serve as a model for other states.

KEYWORDS: environmental equity, sustainable development, local politics, state government agencies, benchmarks, environmental protection, socioeconomic aspects

Introduction

With diminishing natural resources, degrading environmental quality, and warming of the Earth's atmosphere, there is growing awareness of sustainable development (Rogers, 1998; Egger, 2006; Gutman, 2007). Although many of these environmental problems are global, planners and policy makers have in recent years realized the importance of local jurisdictions and promoted sustainable development in urban communities (Prugh et al. 2000; Saha & Paterson, 2008). This new paradigm of addressing global environmental challenges by taking concrete action at the local level is aptly depicted in the aphorism "think global, act local" proposed at the 1972 United Nations Conference on the Human Environment.

In the move to local green governance, the American state of Florida has witnessed several new developments, including the creation of the Florida Green Building Coalition's (FGBC) Green Local Government (GLG) standard. This article reports on a study of the sustainability initiatives of city and county governments in Florida that have adopted this measure. The working definition of sustainability adopted in this research includes the triple notion (or Three Es) of environmental protection, equity, and economic development that has been widely adopted in the sustainability literature (Jepson, 2004; Saha & Paterson, 2008). Specifically, this article attempts to answer the following research questions pertaining to local sustainability planning: 1) Are Florida GLGs demonstrating sustainable development as an overarching development framework? 2) To what extent do the certified GLGs fulfill the criteria of the FGBC standard? and 3) Do the sustainability initiatives adopted by the GLGs integrate the Three Es of sustainable development? This research is potentially significant due to the emphasis in the United States, with its overall lack of federal coordination, on local sustainability. It is the coordination and benchmarking of localized sustainability information that will create a strong foundation for local, state, and national sustainability programs.

We begin with a brief discussion of the concept of sustainable development and a review of relevant threads of the local sustainability planning literature. The article next describes FGBC's GLC standard. This section is followed by an outline of the methodology that we employed and our key findings. We conclude by summarizing how the findings answer each of our three research questions.

Sustainability Planning by Local Government

The modern sustainability movement is often traced to the work of the Brundtland Commission and its 1987 report, *Our Common Future*, that outlined an international approach to sustainable development. The authors famously defined sustainability as

"development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987) and this formulation has remained for more than two decades at the forefront of public policy discussions in many parts of the world. The report focuses in detail on the Three Es of sustainability. This broadened understanding of sustainability that includes social and economic developmental aspects however has not been matched with robust and consistent federal policy initiatives in the United States, in part because of the changing priorities of the executive branch of government. However, there has been a great deal of action at the state and local levels, particularly in urban settings (Krizek & Power, 1996; Betsill, 2001; Conroy, 2006). Although high-density urban areas tend to have smaller ecological footprints due to their compact design, contemporary cities (especially in the United States) have been associated with unsustainable growth, sprawl, inequitable development, resource depletion, and environmental pollution (Rogers, 1998; Egger, 2006; Eaton et al. 2007; Gutman, 2007). However, some policy makers are now realizing the importance of cities in advancing sustainability goals (Campbell, 1996; Prugh et al. 2000; Saha & Paterson, 2008). In fact, numerous local governments around the world have begun to adopt policies and programs to protect the natural environment and to ensure their residents a sustainable quality of life (Krizek & Power, 1996; Maclaren, 1996; Betsill, 2001; Conroy, 2006).

The concept of sustainable development began to be integrated into policy making and planning in the United States during the years following the country's participation in the 1992 United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro. Between 1993 and 2000, the federal government focused on sustainability issues that helped state and local governments, as well as non-governmental organizations (NGOs), address local and regional sustainability concerns (Chifos, 2007). The Clinton Administration's creation in 1993 of the short-lived President's Council on Sustainable Development (PCSD) was a notable effort to coordinate sustainable development at the federal level. The PCSD was entrusted with developing national sustainability goals through innovative economic, environmental, and social policies and strategies. Unfortunately, the council was terminated by the subsequent Bush administration.

There is currently no single federal "office of sustainability" and most efforts are managed or funded by different government agencies, such as the Environmental Protection Agency, the Council on Environmental Quality, and so forth. Under such circumstances, the federal approach to sustainability in the United States involves a variety of efforts without strong coordination or rulemaking. At the same time, grassroots enthusiasm for sustainable development has encouraged planners and academicians to emphasize sustainability within research and local and regional planning (Wheeler, 2000; Chifos, 2007). This mix of research, planning, and activism, influenced by an inconsistent federal government, has created a range of policy changes that have affected how state and local governments conduct themselves.

Warner (2002) conducted a web-based study of the 35 largest cities in the United States that examined how local sustainability efforts in these communities address issues pertaining to environmental justice and found that only five communities built this issue into their local definition of sustainability. A more detailed research project by Jepson (2004), examined 39 policy criteria that comprehensively contribute to sustainability for 390 American cities. This study revealed that most cities in the United States appear to adopt sustainable development not as part of overall community planning, but rather select certain policies in a piecemeal fashion. This finding is supported more recently by Saha & Peterson's (2008) study of 216 medium-to-large cities in the United States using 36 indicators designed to assess sustainability performance. Rather than include sustainability principles in their overall developmental framework, most cities have adopted individual policies for other reasons ranging from cost effectiveness to political expediency. The other major factor affecting local performance appears to be the bureaucratic structure of local governments wherein administration is typically divided into specialized departments with narrow mandates and little or no interaction.

In a study of 75 cities that participated in the Cities for Climate Protection campaign sponsored by the International Council for Local Environmental Initiatives (ICLEI), Betsill (2001) found that sustainability goals are not necessarily the driving force behind changes, but are instead cobenefits of other objectives such as managing budget reductions or enhancing mass transit. It is evident that sustainability and climate change provide the driving impetus for many of these efforts, but they often are motivated by the pursuit of practical local goals.

These national surveys indicate the need to develop comprehensive local responses to sustainable development concerns. However, due to their broad national approach, these prior studies do not highlight regional or local differences. While they reflect the general ways communities are incorporating sustainability into their planning process, they fail to account for regional differences in geopolitical, cultural, climatic, and other factors that either directly or

indirectly influence how a particular city deals with climate change and incorporates sustainable development into governance procedures.

While there are well-established ways of measuring performance in other environmental areas such as water quality, standards for measuring the sustainability of cities are only now emerging. The recent development of voluntary and nongovernmental "green" standards, and the growing interest of communities in adopting these measures to fashion their sustainability plans, remains largely undocumented. This article assesses the impacts of enrolling in one of these local evaluation tools—the FGBC's GLG standard—and reports the results of a survey and web archival research carried out during January, 2009.

The FGBC's GLG Standard

The FGBC is a NGO that has developed technical standards for a variety of environmentally-responsible practices with an aim of providing independent third-party verification for projects in Florida (FGBC, 2008a).[1] The portfolio developed by FGBC consists of five separate standards targeting green buildings, green development, and GLGs.

The GLG standard is conferred upon local governments that conform to a standardized checklist ("Application Tool") of 230 environmental initiatives across a broad range of criteria. These criteria are organized in terms of nineteen local government-department functions (see Table 1). Apart from departments with more definable environmental responsibilities, such as Building and Development, Energy Utility, and Solid Waste, the checklist also includes several less intuitive categories of criteria. For example, under the Property Appraiser/Tax Collector category, points are awarded for the inclusion of environmental certifications and green features of buildings within the public database, as well as for provisions of tax incentives to green development projects. Similarly, under the School Board category, points are awarded to a municipality if local schools implement solid waste reduction, energy monitoring, and recycling programs.

While the overall focus of the GLG standard is to improve the environmental performance of participating local governments, the FGBC does not specifically identify any associated economic or equity/social outcomes. Each criterion in the checklist is assigned a point value and local governments that accumulate a sufficient number to meet a minimum total point value are certified as GLGs (FGBC, 2008b). The certification follows a self-reporting system in which each municipality assesses the environmental performance of its own governmental functions and reports it to FGBC.[2]

The primary objective of the standard is to help local governments improve their environmental performance. However, given the current understanding of sustainability as also encompassing the concepts of economic sustainability and equity, this study attempts to evaluate whether the environmental initiatives undertaken by the certified GLGs within the FGBC framework show any cobenefits in these other two domains.

This article extends the body of local sustainability planning literature in two significant ways. First, this research represents the first attempt to review the sustainability commitment and performance of Florida communities that have adopted the framework of FGBC's GLG standard. The fact that a large number of cities and counties in the state are voluntarily

Table 1 Credit points earned by certified GLGs across departmental categories.

Department	Average Percent Credit Points Earned
Water & Wastewater	73
Solid Waste	62
Public Works & Engineering	53
Energy Utility	52
Planning & Zoning	52
Ports & Marinas	52
Information Services	51
Natural Resources Management	50
Parks & Recreation	49
Housing & Human Services	43
Human Resources	43
Administration	42
Public Transportation	42
Energy Management & Public Safety	36
Agriculture & Extension	30
Building & Development	30
Economic Development & Tourism	30
Property Appraiser & Tax Collector	17
School Board	15

Source: FGBC, 2008b.

[1] The FGBC is a nonprofit 501(c)3 Florida corporation with a mission to "lead and promote sustainability with environmental, economic, and social benefits through regional education and certification programs" (FGBC, 2008b). It is a membership-based organization governed by a board of directors and corporate officers who are elected by the general membership. FGBC members include builders, developers, architects, land planners, realtors, landscape architects, product manufacturers, energy raters, ecologists, educators, university staff, and representatives of government agencies.

[2] According to the procedure established by FGBC, a local government is required to submit all application documents to FGBC after it completes an evaluation and believes it has met the minimum requirements of the GLG standard. The documentation is reviewed by an FGBC-assigned evaluator before the designation is awarded.

Table 2 Certification status of GLGs at the time of survey.

	Certified	Submitted	Pre-submittal	Pending
All local governments reviewed (*n*=26)	10 (38%)	1 (4%)	14 (54%)	1 (4%)
Only municipalities (n=20)	6 (30%)	1 (5%)	12 (60%)	1 (5%)
Only counties (*n*=6)	4 (67%)	0	2 (33%)	0

adopting this standard to demonstrate their commitment to environmental protection makes it important to assess whether this designation also leads to improvements in other areas of sustainability. We make this evaluation in terms of the overall commitment, as well as by assessing the performance of the local governments from the standpoint of the FGBC framework. Consistent with several recent studies (e.g., Saha & Paterson, 2008), sustainable development is considered to include not only environmental protection, but also the related goals of equity and economic development. It is through local application that the performative dimensions of global standards are put into practice. In addition, by limiting the sample of reviewed localities to Florida, this study develops a region-specific body of sustainability related information that can contribute to the identification of political, economic and other regional factors not typically discernible in national sustainability surveys of cities.

Methodology

Since the objective of this research project was to evaluate the sustainability performance of local governments that have adopted the FGBC's GLG standard, the study sample was limited to Florida communities that had declared intent to pursue certification at the time this work began (January, 2009). Figure 1 shows the timeline of GLG applications made by and certifications awarded to participating Florida local governments (both cities and counties).

A review of the FGBC website revealed that a total of 26 local governments, consisting of twenty municipalities (incorporated towns and cities) and six counties, had publicly stated their intention to achieve the GLG designation at the time of this research. While ten jurisdictions (six municipalities and four counties) had received certification, sixteen others were in various stages of the certification process (Table 2). Table 3 displays the names and relevant demographic data for all 26 communities. Aggregate population across the twenty municipalities comprises about 11% of Florida's total population and about 22% of the population living in the state's incorporated areas.[3] Similarly, the six counties surveyed constitute a little over 16% of the state's total population (all population figures based on the 2000 Census).

The research methodology consisted of three distinct steps—an analysis of the websites of all 26 local governments, a survey of sustainability officials of all 26 jurisdictions, and a review of completed GLG certification documents of the ten certified local governments. Each of these steps is described in greater detail below.

To determine the commitment to sustainability, a review of the local government websites of each of the 26 communities was completed, including hypertext (i.e., html) and Portable Document Format (i.e., pdf) documents. We did not review videos or other media. All 26 websites were assessed systematically and thoroughly by first checking the webpages of administrative departments and offices that were believed to handle sustainability planning issues and then by using the search function within each website (where available) to locate any references to the words "sustainable development" and "sustainability." The primary purpose of this exercise was to identify the existence of specific sustainable development initiatives or sustainability planning documents. Several recent studies have adopted web-based archival research methods to study local sustainability efforts. For example, Warner (2002) reviews the sustainability programs in 33 of the largest American cities to determine those that address envi-

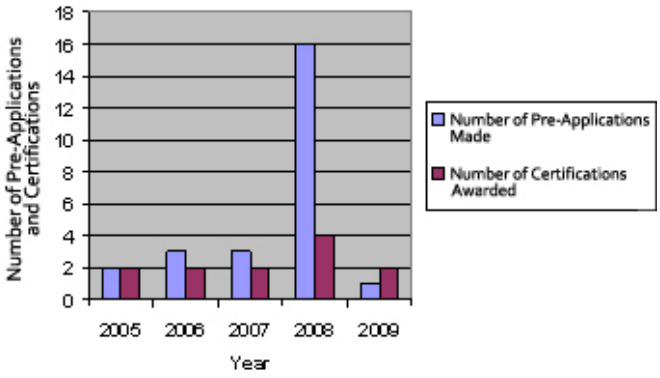

Figure 1 GLG preapplication and certification timeline.

[3] In the United States, an "incorporated area" refers to a municipal corporation, a city or town with its own local government. An "unincorporated area," by contrast, generally connotes a part of a county outside of a municipal jurisdiction.

Table 3 Florida local governments surveyed.

Community Name	Local Government Type	Population (Census 2000)	Population Estimate (July, 2007)	Population Density (per sq mile) (Census 2000)
Belleair	Town	4,067	4,102	2,265.8
Davie	Town	75,720	90,329	2,265.2
DeLand	City	20,904	26,883	1,317.1
Dunedin	City	35,691	36,285	3,438.1
Gainesville	City	95,447	114,375	1,981.0
Hollywood	City	139,357	142,473	5,097.2
Largo	City	69,371	73,298	4,429.1
Miami Gardens	City	100,515	97,286	6,673.3
North Miami	City	59,880	56,185	7,080.0
North Port	City	22,797	54,308	304.9
Orlando	City	185,951	227,907	1,988.9
Palm Bay	City	79,413	100,116	1,247.7
Plantation	City	82,934	84,370	3,815.2
Sarasota	City	52,715	52,488	3,539.8
St. Petersburg	City	248,232	246,407	4,163.1
Tallahassee	City	150,624	168,979	1,573.8
Tamarac	City	55,588	59,668	4,879.8
Tampa	City	303,447	336,823	2,707.8
Tarpon Springs	City	21,003	23,544	2,297.1
Winter Park	City	24,090	27,947	3,281.6
Indian River	County	112,947	131,446	224.4
Martin	County	126,731	138,790	228.1
Orange	County	896,344	1,063,979	987.8
Pinellas	County	921,482	914,444	3,292.0
Sarasota	County	325,957	370,871	570.3
St. Lucie	County	192,695	260,090	336.6

ronmental justice issues through a content analysis of information available on the Internet. While this analysis was not expected to provide a comprehensive picture of local sustainability planning, the information collected through this procedure augmented the survey data. It also gave us a general idea of the importance cities and counties attach to their sustainability initiatives by way of publicizing such information through their websites.

In addition to the web search, we employed a survey to elicit information about sustainable development efforts in all 26 jurisdictions. The purpose was to record the existence of local sustainability planning policies or documents, as well as to gather information on the economic and equity aspects of local sustainable development initiatives. The survey was intended to supplement the web review described above and the information so obtained was expected to be more recent and updated than that found on the Internet. The survey was comprised of two questions:

Question 1: *Does your City/County have a formally adopted Sustainability Strategic Plan, Mission/Vision Statement or a similar policy document outlining the aims, objectives and key strategies pertaining to sustainability? If possible, please submit an electronic copy of all such documents.*

Question 2: *Sustainable development is often defined to include the three dimensions of environment, economy, and equity. Which of the 230 criteria listed in FGBC's Green Local Government Standard do you believe address the economic and equity/societal aspects of sustainable development? Enlist specific initiatives you have undertaken that address these two aspects.*

While the first question was aimed at recording the presence of any policy documents pertaining to a local commitment to sustainable development, the second was used to identify the FGBC criteria that the surveyed local governments considered to address the socioeconomic aspects of sustainable development.

The survey was sent to all 26 cities and counties through e-mail, accompanied by a cover letter outlining its purpose. The communication was directed to the administrative head of each local government

Table 4 Endorsement of sustainable development as a goal or priority.

Sustainability as a goal or priority in local government's public agenda	Yes, formally	Yes, informally	Not Adopted/ Not Found
All local governments reviewed (*n*=26)	14 (54%)	4 (15%)	8 (31%)
Only municipalities (*n*=20)	9 (45%)	4 (20%)	7 (35%)
Only counties (*n*=6)	5 (83%)	0	1 (17%)

(mayor or manager for municipalities, county administrator for counties) with a request to forward it to the appropriate office/personnel. Respondents were requested to electronically return the completed survey and any additional supporting documents. In cases of nonresponse, a reminder e-mail was sent two weeks after the survey was first distributed. In a few cases, telephone calls were made in lieu of electronic reminders wherever telephone numbers of respondents were readily available. Out of the 26 surveys sent, eleven were completed and returned, a 42% response rate. Responses were received from six cities (30%) and five counties (83%), a significantly different rate, probably due to counties' larger administrative structures.

The ten jurisdictions that had received the GLG certification at the time of the research were separately requested to provide an electronic copy of the certification's Application Tool document. The document is a spreadsheet that lists all the certification criteria fulfilled by the applicant local government across nineteen administrative departments. A review of these documents thus helped us to assess the extent to which the certified GLGs met the sustainable development objectives within the FGBC framework. Only ten out of the total 26 jurisdictions were sent this request because the others were still going through the process of certification and thus not expected to have their applications ready. Five local governments (comprising four counties and one city), out of the total ten, provided their completed Application Tool documents within the requested timeframe.

Findings

Commitment to Sustainability Beyond Adoption of Specific Initiatives

This study adopts the classification system developed by Saha & Paterson (2008) to determine whether a community has "formally" or "informally" established sustainable development as a goal or priority. The commitment to sustainable development was considered "formal" if the local government was found to have adopted a specific ordinance, mission, or vision statement; a strategic plan; or a similar policy. However, if a local government had shown interest in sustainable development, but had not yet codified its intent in a specific policy document, the commitment was considered "informal." The presence of specific policy documents pertaining to local sustainable development planning was recorded through the web review and the survey responses. About 70% (18 out of 26) of the municipal and county websites reviewed were found to have web pages dedicated to sustainable development information (see Table 4). The websites of the larger jurisdictions (i.e., the six counties and the cities of Tampa, St. Petersburg, and Orlando) had more substantive information pertaining to their sustainability initiatives compared to those of smaller cities and towns. A majority of these local governments had chosen the formal route of endorsing sustainability which meant they had a sustainability policy in place to guide their decision-making process.

Whereas the strategic plans of the larger cities often focused on the complex issues of managing urban expansion and providing services to their rapidly increasing populations, those of smaller communities were limited to nature preservation, local community identity, and economic development aspirations. As expected, the specific issues covered within individual sustainability commitments varied widely, reflecting local priorities; however, all localities made reference to the common themes of environmental, social, and economic concerns.

Another way to ascertain local government commitment to sustainability is to identify the existence of a separate office of sustainability, or at the least the presence of staff assigned responsibility of carrying out sustainability activities (Saha & Paterson, 2008). Table 5 shows that only 12% of the local government websites that we reviewed were found to have either a dedicated office of sustainability or a specific department formally in charge of sustainability activities. For example, the Office of Sustainability in both Miami-Dade and Sarasota Counties, as well as the Office of Planning, Zoning, and Economic Development in the City of Plantation, were exclusively responsible for carrying out the sustainability initiatives of the respective local governments.

About 42% of all local government websites identified individual(s) assigned with implementing sustainability policies. Some examples of individual sustainability positions are "sustainability coordina-

Table 5 Presence of office or individual(s) responsible for sustainable development.

Office or individual(s) responsible for sustainable development	Office	No Office but Individual(s)	No Office or Personnel
All local governments reviewed (*n*=26)	3 (12%)	11 (42%)	12 (46%)
Only municipalities (*n*=20)	1 (5%)	6 (30%)	13 (65%)
Only counties (*n*=6)	2 (33%)	4 (67%)	0

tors" in the cities of Plantation and North Port and a "green officer" in Tampa. The amount of information available on the duties of these personnel varied widely among these cities and counties. A significant number of municipalities (65%) were found not to have any clearly identifiable office or personnel dedicated to sustainability related activities.

Environmental Performance within the GLG Framework

The cities and counties were also assessed on their performance within the framework of GLG standards, both in terms of the extent to which environmental criteria were met and the distribution of efforts across a range of government departmental functions. A review of the FGBC website showed that out of the 26 Florida local governments that had expressed intent to adopt the GLG standard, only ten communities had completed the certification process and officially received the title at the time of this study (see Table 2).[4] Six of these certified local governments were cities, and the other four were counties. We requested that all 26 local governments that had achieved (or were pursuing) the GLG designation provide us with an electronic copy of the Application Tool if they had already completed and submitted it to FGBC. This document contains a checklist of criteria or credit points across nineteen government departments, maximum numbers of points available, and the actual number of credits achieved by the local government undergoing certification. Out of the ten local governments that had completed the entire certification process (including the Application Tool document), for reasons inexplicable to us, only five of them provided us with this document.

A review of the Application Tool documents submitted by the five certified local governments showed that they had collectively undertaken initiatives across a wide range of government functions such as solid waste and energy utility (see Table 1). The fact that many of these initiatives were cross-departmental initially appears to validate FGBC's claim that the standard promotes intragovernmental communication, which in turn leads to better coordination and enhanced administrative efficiency.

However, closer scrutiny reveals that not all government functions have been equally addressed. This finding is reflected by the uneven distribution of points earned across the nineteen categories in Table 1. It is evident that the five cities and counties collectively focused more on some departmental functions and neglected others, reflecting areas of over- and underactivity pertaining to sustainability. Some of the high scoring departments were Water and Wastewater and Solid Waste, whereas Property Appraiser/Tax Collector and School Board were among the lowest scoring. While our research did not investigate or hypothesize about possible causes of this disparity, the variation may be because the initiatives that scored higher credit points had already existed as part of traditional planning practices and it was thus easy to reinvent them in the new sustainability framework. The activities carried out successfully had been the most feasible both technologically and financially and policies and programs targeting issues that found the most public support and/or political will were adopted at the onset.

It is moreover important to keep in mind that a higher numerical score does not necessarily translate into a superior environmental or sustainability performance; after all, it is difficult to put comparable numeric values on individual sustainability activities.[5] Our assumption, however, is that a more homogenous distribution of credits earned across departments indicates more thoroughgoing efforts to address the environmental, economic, and social impacts of a local government's gamut of functions and services, resulting in more balanced and comprehensive sustainability planning.

[4] Since the time of this research, there has been a marked increase in the number of Florida cities and counties that have applied for the GLG standard. As of June 1, 2010, a total of twenty local governments were certified and 28 others were undergoing the certification process (http://www.floridagreenbuilding.org/files/1/File/Certified_Governments.pdf).

[5] The GLG certification program attaches uniform numerical scores to activities with differing environmental values (that are arguably difficult to quantify and/or compare). Some experts argue that the correlation is much more complex. As a result, even though a "spreadsheet" approach to green certification has some value in broadly assessing environmental performance, one should keep in mind the limitations posed by numerically ranking environmental values.

Addressing the Three Es of Sustainability

Planning for sustainable development is increasingly seen as encompassing not only environmental protection, but also includes closely related economic and social principles. According to FGBC, the major goal of the GLG standard is to help local governments improve their environmental performance and it does not claim to promote the other two goals. However, given the current understanding of sustainability, this study evaluated whether the initiatives undertaken within the FGBC framework also address the economic and social aspects.

The governments were surveyed to identify any criteria regarded as relevant to the economic and social dimensions of sustainability. The survey responses were collated to create two lists of certification criteria that the respondents collectively identified as addressing these aspects of local sustainability planning (see Tables 6 and 7). The Application Tool documents received from the five certified jurisdictions were also evaluated to assess the extent to which they evinced the criteria in these two lists. These five local governments met an average of about 16% of the economic criteria and about 50% of the social criteria.

Table 6 GLG standard criteria pertaining to economic aspects of sustainable development.

Offer an incentive(s) to create organic farms or sustainable/water efficient agriculture.
Offer an incentive(s) for FGBC or Leadership in Energy and Environmental Design (LEED) certified commercial and institutional buildings.
Offer an incentive(s) for FGBC or Energy Star certified green homes.
Offer an incentive(s) for FGBC certified green developments.
Offer an incentive(s) for local professionals to attend green building classes offered by others.
Conduct a green building awards program.
Offer an incentive(s) for location of green businesses within city/county.
Offer special promotion for local eco-hotels.
Offer an incentive(s) for green redevelopment.
Offer an incentive(s) for disaster mitigation.
Offer an incentive(s) for distributed generation.
Offer an incentive(s) for commercial building.
Offer an incentive(s) for construction of green affordable housing.
Offer an incentive(s) for location-efficient affordable housing.
Offer an incentive(s) for local tax based or other alternative fuel vehicles.
Offer an incentive(s) for low pollution engines.
Offer an incentive(s) for certified green properties.
Offer an incentive(s) for lands qualifying as historic, high - water recharge, greenbelt, and so forth.
Offer an incentive(s) for local businesses that utilize environmentally preferable purchasing (EPP) or other solid waste reduction strategies.

Table 7 GLG standard criteria pertaining to societal aspects of sustainable development.

Offer free or discounted green products to the public.
Develop a historic preservation ordinance.
Develop funding mechanism to aid with historic preservation.
Use of alternative fuel vehicles and/or bicycle patrol for urban/neighborhood areas.
Police trained in crime prevention through environmental design.
Public safety staff attends training on “healthy street” design.
Affordable housing constructed by city/county and other parties mandated to be green.
Operate an environmental demonstration/learning center
Maintain organic community gardens
Encourage mixed-use zoning/development

The economic criteria that they identified are, on one hand, all more or less themed around providing incentives to sustainably committed individuals, businesses, and activities, including promotion of organic farms, construction of green buildings and development projects, provision of green affordable housing, and incentives for green businesses and ecotourism. Criteria based on social issues, on the other hand, range from preservation of community historic sites, to provision for alternative-fuel vehicle/bicycle neighborhood patrols, to encouraging mixed-use development, to running community environmental learning centers. None of the respondents made any clear reference to equity considerations in local sustainability planning, an absence that conforms to nationwide community surveys carried out by Warner (2002) and Saha & Paterson (2008). It is pertinent to note that we do not negate the possible existence of additional economic and/or equity themed sustainability activities in any of the surveyed jurisdictions since the present study is limited to only local sustainability initiatives within the framework of FGBC’s GLG standard.

Conclusion

Our research evaluated the commitment and performance of local governments in Florida with regard to the implementation of FGBC’s GLG program. While we adopted Saha & Paterson’s (2008) strategy to evaluate the local commitment to sustainability planning, this work represents a pioneering effort to review the sustainability performance of FGBC-certified GLGs in Florida. Results of this study provide three important findings pertaining to local sustainability planning: the governments studied have included sustainability objectives in their strategic planning documents, sustainable development initiatives are not spread evenly across departmental

functions, and sustainability initiatives do not equally address the three aspects of sustainable development *vis-à-vis* environment, economy, and equity.

First, some of the municipalities and counties in Florida that have adopted the GLG standard seem to be at the early stages of embracing the principles of sustainable development as an overarching planning paradigm guiding local policy making. Several localities in the state have introduced elements of sustainability within their strategic plans and other policy documents. Conventional wisdom and personal observation suggest that such a broad political commitment to sustainability is more widespread among the FGBC-participating municipalities than other Florida communities. According to Wheeler (2000), an endorsement of sustainable development through such policy documents leads to "consensus on directions for sustainable metropolitan development…inspires individuals to take action, and (if backed by political authority) actually brings about change." Creation of a dedicated "sustainability office" and/or presence of staff devoted to carrying out sustainability activities is yet another way to ascertain local government commitment. An established sustainability office and/or staff was not found in many of the smaller cities and towns in the study sample, indicating that these communities may be significantly influenced by the availability of local financial and bureaucratic resources and may not entirely indicate the local government's commitment to sustainability.

Second, irrespective of a broader sustainability commitment, local government performance in terms of actual initiatives undertaken within the FGBC framework did not appear to be comprehensive. Certified local governments were found to have achieved just enough credit points to make the certification level. Also, sustainability criteria were not fulfilled evenly across the board, with some governmental departments seeing fewer sustainable development initiatives than others. This observation implies that although governments did formally adopt the sustainable development paradigm, the actual implementation of initiatives is subject to several local factors including political will, competing priorities, and economic and technological feasibility. It would be instructive to examine whether complexity or size of local government is partially responsible for such variations.

Finally, this study shows that a majority of the sustainability initiatives undertaken by local governments revolve around environmental issues such as water-quality protection and waste-disposal programs. Municipal and county efforts were found to inadequately address the economic and social dimensions of the sustainable development paradigm. This finding is consistent with Saha & Paterson's (2008) and Warner's (2002) observations that the Three Es of sustainable development have failed to translate into reality at the local government level in the United States. While this study does not deny the possibility of sustainability aspects being partially addressed in existing equity or social justice programs within the surveyed communities, it is evident that any such initiatives are not part of the local sustainability discourses under the GLG program.

The study has examined sustainability efforts at the municipal and county level in Florida. As it is evident that local governments are in the forefront of the environmental sustainability movement in the United States, they will need to broaden their approach to achieve the global sustainable development objectives of environmental protection, economic development, and social equity that are outlined in the Brundtland Report. While voluntary, nongovernmental green certification programs such as FGBC's GLG standard are changing the way local governments approach planning, such programs need to widen their focus to include socioeconomic aspects so that their outcomes are better aligned with contemporary global sustainability objectives. There is no doubt that FGBC is beginning to improve the environmental sustainability of Florida's cities and counties by focusing efforts through a benchmarking matrix. However, new versions of FGBC's GLG criteria should expand to more effectively encourage the state's communities to integrate the three pillars of sustainability.

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ARTICLE

Developing policies for green buildings: what can the United States learn from the Netherlands?

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Political jurisdictions in the United States have begun to develop plans that address green buildings, a topic on which the Netherlands has extensive experience. This article analyzes the literature on Dutch green buildings to look for lessons that might be relevant for the development of polices in the United States. Through a metasynthesis of seventeen studies on green building policies in the Netherlands, the study identifies patterns in the literature and creates a holistic interpretation. These data are compared with the literature on green building policies in the United States. The article concludes that guidance from the federal government—including a stronger research agenda for green building policy issues—could help spur innovation. Reliance on voluntary green building certification has very limited potential and stronger regulations are needed in the United States to minimize the environmental impacts of buildings. A flexible, broad policy system is also required.

KEYWORDS: buildings, housing, construction, energy efficiency, sustainable development, planning, stakeholders, public policy, sociopolitical aspects

Introduction

One of the first countries to enact policies and implement plans for green buildings is the Netherlands, where such initiatives began during the mid-1980s and advanced significantly during the mid-1990s before commitment waned in the new century. The United States, in contrast, is just starting to develop a policy system for green buildings. Planners in the country have only just embarked on development of policies and plans for green buildings during the last few years, and most of these programs are confined to the municipal level with little coordination or guidance from either state or federal governments. Because green building policies have a long history in the Netherlands, is of recent interest in the United States, and is important in mitigating global climate change (McKinstry, 2004; Northrup, 2004; Osofsky & Levit, 2008; Sussman, 2007; 2008; Codiga, 2008; Irvin et al. 2008), there is likely to be benefit to analyzing the Dutch experience and literature for insights that could help formulate an American approach.

The current article takes up this challenge. Because of significant differences between the political systems and cultural contexts of the two countries, this treatment focuses on theory development, not on specific policy techniques such as zoning, building codes, or incentives. The first part briefly summarizes the historical development and contemporary state of green building policies in the Netherlands and the United States. This discussion is followed by a review of the methodology used for this research. The findings are divided into eight sections: conceptual framework, the evolving idea of green buildings, research and education, policy development networks, methods of building assessment, the focus of green building policies, cost and flexibility, and effectiveness. The article concludes by outlining some ideas that the United States can take away from the history of Dutch green building policy.

Green Building Policies in the Netherlands

The Netherlands first began to devote serious political attention to green buildings in 1973 after the Organization of Petroleum Exporting Countries (OPEC) imposed an oil embargo against many western countries—including both the Netherlands and the United States—that drastically reduced supply and increased price. The resulting instability in energy markets prompted the Dutch government to reevaluate all energy use in the country, including in buildings. A major policy shift during this period was adoption of the first Dutch Energy Policy document in 1974 and the completion of several subsidized green buildings (Melchert, 2007).

During the 1980s, green building policy in the Netherlands became more institutionalized, prodded by two publications: the report of the Brundtland Commission in 1987 and the response of the Dutch government the following year, *Zorgen Voor Morgen* (Concern for Tomorrow), that concentrated on the

status of the natural environment (Hajer, 1995; Gouldson & Murphy, 1998).

The country's first National Environmental Policy Plan (NEPP), *Kiezen of Verliezen* (To Choose or to Lose), based in part on the Brundtland Commission's report, was issued in 1989 and it gave high priority to the construction industry (VROM, 1989). In 1993, the Dutch government released its second such plan, focusing on the importance of separating economic growth and pollution (VROM, 1993). The third plan, published in 1998, sought to promote overall prosperity (VROM, 1998) and the fourth plan, issued in 2001, stressed the need to balance quality of life and environmental objectives (VROM, 2001; Sunikka, 2001). The Dutch government issued an action plan for sustainable construction in 1995 that outlined broad goals and policies for all areas of green buildings, including energy use, water consumption, and air quality. The plan was revisited and updated in 1997 and 1999 (Bossink, 2002). Despite these advances at the national level, implementation of green building programs was left up to the discretion of individual municipalities.

The national government became much more involved in green building policies in 1996 with the National Sustainable Building Packages. Four separate packages were issued and they addressed residential and nonresidential buildings, infrastructure, and urban planning. The National Packages contained extensive and detailed specifications for green building from the urban design scale to the building-component scale (Melchert, 2007) and were presented in a clear format that classified sustainable measures according to the sets of environmental issues to which they contributed. The National Packages were based on life cycle analysis to assess the sustainability of each of the measures and to give corresponding cost information (van Bueren & ten Heuvelof, 2005). They were typical of Dutch environmental policy, which is to say that the construction industry was expected to take part in negotiations to develop voluntary covenants for sustainable building that the industry would be required to follow.[1]

While the sustainable building programs in the Netherlands were expanding, the country was also working to find ways to address global climate change and to reduce greenhouse-gas emissions. In 1995, the Dutch government enacted the Energy Performance Standard that specified the amount of energy that new industrial and office buildings would be allowed to use. In addition, existing buildings were required to reduce their energy use by 25% over ten years.

Throughout the 1990s, and with the issuance of the NEPPs, the decision-making process in the Netherlands became more open and flexible, with greater autonomy given to local authorities. In addition, industry groups came to be consulted on many issues. The system of communication and open negotiation on environmental policy matters occurred in almost every industry in the country (Arentsen et al. 2000). For instance, regulators worked hard to negotiate covenants to reduce pollution in the construction industry and one account notes that the covenants covered "90% of the pollution, waste disposal, recycling and energy use of the industry, [and] construction and energy sectors" (Keijzers, 2000).

By the late 1990s, sustainable building policies in the Netherlands contained a wide variety of instruments and strategies including demonstration projects, mandatory policies, voluntary incentives, and covenants with industry groups. However, these innovations in sustainable building policy began to unravel in 2002 when a rightward leaning coalition assumed control of the government and support waned for the hierarchical, top-down approach to planning and environmental policy previously carried out by the Ministry of Housing, Spatial Planning and the Environment (Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheers, or VROM) (Bontje, 2003).

Green Building Policies in the United States

Like the Netherlands, the United States first devoted attention to the issue of green buildings after the oil embargo of 1973. While the Dutch persevered on this front as we have seen, interest among Americans faded by the 1980s. Green buildings did not reemerge as a policy issue in the United States until about ten years ago and it is still in its infancy. As a result, green buildings have a much shorter history in the latter case and there is less coordination than in the Netherlands. Green building issues lack guidance from the federal government (and most states), and most policy innovation to date has been at the local level.

The first municipal green building initiative in the United States took root in Austin, Texas in 1991. The program initially used a tool to evaluate single family homes that had been developed by staff of the local electric utility, Austin Energy, and it evolved

[1] The policy construct of voluntary covenants in the Netherlands is less voluntary than it might seem. As Liefferink & Mol (1998) explain, "So-called voluntary agreements between the state and private actors, particularly industry, are in fact seldom entirely voluntary. Quite often, they are linked to more general legal obligations and can as such rather be seen as implementation agreements. And even if they are not placed in a broader legal context, the state may use the introduction of formal regulations as a stick to beat with if 'voluntary' negotiations do not bring the desired results."

over time to cover commercial, multifamily, and public buildings.[2] Since Austin developed its program in 1991, other cities and counties in the country have experimented with green building policies such as tax incentives (Rosenberg, 2001; Busch et al. 2008), density bonuses (Retzlaff, 2005), zoning requirements (Circo, 2008; Retzlaff, 2009), government-building mandates (Kibert, 2002; Del Percio, 2004; King & King, 2005), and comprehensive green building planning programs (Theaker & Cole, 2001).

It is not clear how many green building polices have to date been adopted in the United States.[3] One survey of 661 of the largest American cities found that 92 of them had green building programs (Rainwater, 2007). A database of green building initiatives assembled by researchers at the University of Wisconsin included 194 programs in 2009 (Gruder, 2009).

At the federal level, green buildings were the subject of a memorandum of understanding (MOU) between the Office of the President and seventeen federal agencies in 2006. Signatory agencies endorsed "federal leadership in the design, construction, and operation of high-performance and sustainable buildings." However, the MOU did not commit the agencies to a policy of actually constructing green buildings (OFEE, 2006).

Multiple approaches to assessing the sustainability of buildings exist in the United States. A commonly used method is Leadership in Energy and Environmental Design (LEED) that has multiple assessment systems for many types of buildings including new construction, homes, and commercial rehabilitation, as well as one for neighborhood design. An extensive body of literature now exists on the assessment of buildings, technical issues, construction methods, and design in the United States (Cole, 1997; 1998; 2006; Brochner et al. 1999; Larsson & Cole, 2001; Theaker & Cole, 2001; Retzlaff, 2008; Garde, 2009), but little attention has been given to broader policy issues.

Methodology

Qualitative metasynthesis is the integration of the findings of different, but related, qualitative studies with the purpose of interpreting rather than aggregating results. The method was developed in the fields of education and health, although other researchers have begun to use it in recent years (Martin & Helge, 2000; Gough & Elbourne, 2002; Lauria & Wagner, 2006; Howland, 2007). Qualitative metasynthesis has many potential uses for informing policy decision making because analyses are often predicated on qualitative studies of single cases. Moreover, it is often necessary to synthesize and interpret across studies and to develop evidence-based policy (Sherwood, 1997; Davies & Nutley, 1999; Maclennan & More, 1999). Metasynthesis also has the potential to help inform international comparative policy analysis because of the importance of contextualizing findings.

Metasynthesis is not just concerned with summarizing existing research findings, as in a literature review. It is rather used to develop new interpretations and to create new knowledge (Noblit & Hare, 1988; Gough & Elbourne, 2002). Metasynthesis uses the findings of existing studies as primary data (Zimmer, 2006), with each study deployed as a separate data point (Weed, 2005). In other words, the goal of metasynthesis is to create a holistic interpretation of the subject—not to aggregate or average the studies (Jensen & Allen, 1996; Denyer & Tranfield, 2006).

The metasynthesis for this research analyzed literature on Dutch and American sustainable building policies from 1998 to the present. Inclusion criteria were broadly defined as studies that used a qualitative research approach to assess sustainable building policies in the Netherlands or the United States since the issuance of the National Packages in 1996. Only articles published in refereed journals were included to assure that the research was academic in nature and to avoid opinion pieces (Sandelowski & Barroso, 2003). It is important to note that studies highlighting technical, construction, or building performance issues—which account for the majority of the green building literature—were not included in this sample. Only research that discussed policy issues (in the entire paper or part of it) was included. Seventeen studies of Dutch green building policies and four of American green building policies were included in the study.[4] The Netherlands has a much longer history and larger literature on green building policies than is the case for the United States. While the size

[2] An usual arrangement for the United States, the City of Austin owns the electric utility company Austin Energy.

[3] While the United States Green Building Council (USGBC), through its LEED program, has some characteristics of a policy clearinghouse, this is misleading. Other systems are used—Green Globes and the National Association of Homebuilders (NAHB) system, for example. Some green building requirements for the construction of affordable housing are based on the system developed by Enterprise Communities. Furthermore, many municipalities use a system formulated on an internal basis because they cannot meet certain LEED criteria (such as density requirements).

[4] The author of this article authored two of the studies analyzed in the metasynthesis described here.

of the American literature is perhaps too small for metasynthesis, the focus of this research is on how the United States can learn from the history of green building policies in the Netherlands. Therefore, the American literature was analyzed more for comparative purposes than to interpret and build theory. Appendix A describes the literature used in the metasynthesis.

The metasynthesis for this research follows closely the methodology outlined by Sandelowski & Barroso (2007). In the initial phase, the findings were grouped into a common coding scheme. Findings were defined as any conclusion that was drawn directly from the evidence in the study. The coding scheme was developed through a combination of the literature review and from an analysis of the studies themselves. Tying the coding scheme to the literature review allowed this investigation to be linked to research questions, while tying it to the studies themselves fine-tuned the coding scheme by adding new categories that were directly pertinent to the text (Gaber & Gaber, 2007). A second pass at coding the findings was completed within three days to ensure that the process was consistent. Any discrepancies (which were minimal), such as when something was identified as a finding in one pass and not in another, were reexamined using the original documents (Wilson & Lipsey, 2000). Using the procedure above, the findings of the studies were grouped into fourteen categories: flexibility, cost issues, research, education, policy development, policy expansion, technical expertise in sustainable construction, redevelopment of existing buildings, new construction, energy issues, holistic focus of green building issues, methods of assessing buildings, policy outcomes, and sustainable housing (see Table 1). The categorized findings that dealt with similar theoretical issues were later grouped together, allowing generalization about the major themes in the data. The coded findings were then regrouped several times into more precise themes.

Table 1 Formulation of Thematic Subcategories

Theme 1: The evolving idea of green buildings
Subtheme A: Policy expansion
Theme 2: The need for a strong research program
Subtheme A: Research
Subtheme B: Education
Theme 3: Policy development networks
Subtheme A: Policy development
Subtheme B: Technical expertise in sustainable construction
Theme 4: Methods of assessing the sustainability of buildings
Subtheme A: Methods of assessing buildings
Theme 5: Narrow focus of green building issues
Subtheme A: Redevelopment of existing buildings
Subtheme B: New construction
Subtheme C: Energy issues
Subtheme D: Holistic focus
Subtheme E: Sustainable housing
Theme 6: Cost and flexibility
Subtheme A: Flexibility
Subtheme B: Cost
Theme 7: Effectiveness
Subtheme A: Policy outcomes

As the clustering of the coded findings became more refined, I was able to develop new conclusions about the process, context, and experiences of sustainable building policies in the Netherlands and the United States. Seven broad themes ultimately emerged from the analysis: the evolving idea of green buildings, research and education, policy development networks, methods of building assessment, the focus of green building policies, cost and flexibility, and effectiveness. Both the Dutch and American literatures focused on each of these themes to varying degrees; however, the limited amount of published work on the United States made it somewhat difficult to analyze. As a result, the two countries had an imbalance of emphasis on the themes, particularly on the narrow focus of green building issues and on cost and flexibility (both of which were much more prominent in the Dutch literature).

MetaSynthesis of Dutch and American Literatures

Conceptual Framework

The metasynthesis identified seven broad and interconnected themes in the Dutch and American literatures.

1. The evolving idea of green buildings: green building policy development has been dependent on past events and shifts in attitudes.
2. The need for a strong research program: research and education on both the technical and policy aspects is crucial to the strength and innovativeness of green building initiatives.
3. Policy development networks: expertise and interest in green building issues is dominated by a small network of government and industry professionals.
4. Methods of assessing the sustainability of buildings: government and industry leaders view how building-assessment systems influence policy implementation.
5. Narrow focus of green building issues: policies take a relatively constrained view of sustainability.

6. Cost and flexibility: actual and perceived cost increases for green buildings hinder widespread adoption and innovation.
7. Effectiveness: the effectiveness of green building policies is spotty and the ambiguous concept of green buildings has contributed to policy failures.

Both the Dutch and American literatures highlight these seven themes to various extents, although there is a much larger green building policy literature in the Netherlands. Each of the themes is discussed below.

The Evolving Idea of Green Buildings

Without the shifts in attitudes and policies that have occurred in the Netherlands over time, green building policies in the country would look very different today. During the 1970s, the issue was motivated by a need for deep-seated change as advocates of green buildings—primarily the middle-class—sought to disconnect buildings from the existing infrastructure grid and to develop several prominent self-sustaining "ecocommunities." Because of this radical image, interest in green buildings did not translate into changing lifestyles for the broader population. Further, the popular image of green buildings was not one of holistic sustainability, but of energy efficiency, a narrow focus that still persists today.

During the early 1980s, the Dutch government began to think about the environment in a more integrated way and to realize the need to include more stakeholders in environmental decision making. Industry—including the construction industry—came to be viewed as a partner in solving environmental problems rather than as just a target group for regulation. Public officials also began to understand the need for citizens to have a voice in environmental decision making and that policies needed to integrate environmental concerns into daily life. During the 1990s, the Dutch government gradually shifted its attention from pollution prevention and reactive environmental policy to sustainable development and proactive environmental policy. Nonetheless, sustainable building policies continued to focus on building technologies and the production cycle instead of on building consumers and this emphasis was particularly attentive to energy-efficient technologies.

Despite the fact that the United States and the Netherlands had similar early experiences with green building during the 1970s, interest among Americans waned and the country today does not have the same long history of policy action. These circumstances mean that the American literature is sparser. However, local jurisdictions that have adopted green building policies have tended to expand them over time and green building polices in the United States have generally grown out of larger sustainable development initiatives contained in comprehensive plans. American cities have begun to develop green building policies by using incentives and voluntary measures and they have gradually moved toward stricter requirements for private development. The federal government has also evolved to embrace green building, with many agencies committing to construct green buildings for all or some of their activities.

In both countries, the progression of green building policies is usefully viewed from the history of policy and cultural shifts. Green building issues, like many other policy matters, have built upon a path-dependent history of changes in public attitudes. Although the United States began to encourage green building several decades later than the Netherlands, both policy systems have become products of their current contexts, and both situations are highly dependent on past policy changes and attitude shifts. For example, green building policies in the United States are highly decentralized, with minimal guidance from either the states or the federal government, whereas the Dutch system is built on more expansive national influence and the role of the central government has grown over time.

The Need for a Strong Research and Education Program

Another major theme from the metasynthesis centers on the need for strong research and education programs, though there are important cross-national differences in emphasis. The American literature is more interested in educating developers and city officials about green buildings while Dutch scholarship focuses on research and education to promote innovation of green buildings and green building policies and to change personal behaviors.

Some of the research on green buildings in the Netherlands has taken place through demonstration projects designed to showcase new advances in building technologies. Although these initiatives have been able to disseminate new knowledge, only a small network of experts and developers is familiar with them and, as a result, there has been an implementation deficit. Innovation has therefore been unevenly spread throughout different domains and has not garnered widespread attention.

In addition, researchers in the Netherlands have identified building-assessment methods as important in the past, although it has not been a focus of recent work. To some extent, the Dutch literature, since the issuance of the National Packages, has moved past discussions of how to measure buildings for sustain-

ability and how to define sustainability. While the National Packages have allowed the Dutch to focus more on implementation in recent years, building assessments and the definition of sustainability remain major priorities in the United States and implementation issues have received relatively little attention.

The relationship between the Dutch National Packages and research, innovation, and education is another theme that emerges from the metasynthesis. While the National Packages did succeed at disseminating information about green buildings quickly and efficiently, much of that knowledge has remained relatively stagnant. Further, the metasynthesis suggests that users of the National Packages have little need to become educated about green buildings beyond the contents of the National Packages. Also, the National Packages often do not help users understand the unique and contextual circumstances that could generate the most environmental benefit from sustainable technologies.

Policy Development from a Small Network of Actors

One important theme in the Dutch literature that is lacking in its American counterpart is that a small network of government and industry professionals dominates green building issues. This is because government officials in the Netherlands prefer to work through established relationships, negotiations are easier when both parties already know one another, and green building construction in the country is controlled by a few specialized construction companies. The National Packages were developed by a network of people already active in the field who had previously worked together, a situation that has contributed to a lack of learning and innovation over time. The prevailing situation is problematic for smaller developers and other professionals who did not participate in the negotiations, but must nonetheless adhere to the agreements.

While the American literature has not focused on the narrow scope of actors involved in developing green building policies, research has briefly touched on the idea that—as in the Netherlands—a limited number of specialized construction firms and architects dominates the sustainable construction field in the United States. Researchers in both countries see the inadequate number of people with expertise in green buildings as a barrier to implementing sustainable building polices. Interestingly, although one of the goals of the National Packages in the Netherlands has been to disseminate information about sustainable buildings, many small architecture and development firms continue to deal almost exclusively with conventional buildings.

Methods of Assessing the Sustainability of Buildings

While researchers and professionals in both countries have concentrated on assessing the sustainability of buildings, this has been a greater focus in the United States in recent years. Since the National Packages were issued, the Dutch literature has moved toward implementation rather than assessment. This is perhaps because, as some researchers point out, the National Packages "have become a sort of sustainable building standard in the Netherlands" so there is less need for an ongoing discussion about the methods for assessing buildings (van Bueren & ten Heuvelof, 2005).

The United States, in contrast, has many competing methods for assessing buildings for sustainability—each with significant differences—and practitioners and researchers have not settled on one, or even several, methods. Much of the activity in the country focuses on the details of the assessment systems themselves rather than on implementation issues. Research in the United States has analyzed the technical details of the various building-assessment systems (e.g., LEED and Green Globes) such as their approach to various environmental issues and spatial scales, their underlying values, and how they determine criteria and point values.

Nonetheless, the Netherlands and the United States have experienced similar problems with building-assessment methods. Both American and Dutch architects find the use of life cycle analysis to be difficult because it is not always suited for examining certain key issues of sustainability and difficulty achieving the required quantification. For example, it is hard to quantify the benefits inherent in walkable neighborhoods, diverse communities, and tree-lined and shaded streets—all of which are sources of credits in the LEED system for new development. Furthermore, building-assessment methods are more complicated when applied to the rehabilitation of existing buildings than to new construction due to the special challenges of making existing buildings more sustainable.

Narrow Focus of Green Building Issues

Research on Dutch and American green building policy systems highlights that both countries have a constrained view of sustainability in terms of emphasizing energy issues, new construction, and housing. Energy has continued to dominate green building policies in the Netherlands since the modern movement began during the 1970s. Although the Dutch National Packages contain criteria for many environmental issues such as water and air quality, it is mainly the emphasis on energy that has been strengthened over time. This situation is perhaps due to the

fact that energy efficiency is a convenient focal point for performance-based regulations because it can often be verified objectively, while other environmental issues, such as indoor-air quality for the finished building, are more difficult to quantify.

Despite the attention accorded to energy in the Netherlands, some research suggests that compliance with energy mandates has been spotty. For example, building plans often contain energy-efficiency measures, but they are not included in the final buildings. Policies beyond the National Packages and building codes, such as tying the provision of energy efficiency to occupancy permits, could help with the implementation problem.

Dutch and American green building policies are also narrow in the types of buildings that they target. Many initiatives are geared toward the greening of new construction instead of existing buildings. Dutch building policies require quantification of the environmental impact of new construction, but do not compel the same level of analysis for rehabilitation. Similarly, policies in the United States that require green building certification primarily do so for new construction.

Another way that the issue of green buildings has been constrained is in terms of the definition of sustainability. Commentators have criticized both national systems for ignoring the economic and social dimensions of sustainability. Dutch researchers also point out that green building policies have downplayed the importance of water management and siting. Further, green building policies in the Netherlands rarely address sustainability on a scale larger than the individual building. American researchers echo this observation and note that green building policies across the country are too concerned with building materials and site-specific measures and often ignore larger issues such as site selection, urban design, and neighborhood linkages. A possible explanation for this narrowness is that broader issues such as siting and economic and social concerns are much more difficult for individual building owners and developers to tackle and much harder for government agencies to address through policy measures.

Cost and Flexibility

In both countries, researchers have noted that the time span for recovering the costs of investments in green buildings is prohibitively long and that the investment is usually shouldered by developers (who often do not enjoy the cost savings). Analysis carried out in the Netherlands and the United States has found that cost is a significant obstacle to green building in all sectors. Dutch and American researchers have identified numerous financial barriers such as the perceived cost of managing sustainable buildings, the lack of market demand, the limited availability of some sustainable products, the systematic and regulatory barriers to sustainable construction, and the unwillingness of consumers to pay for sustainable features. These concerns persist in the Netherlands despite findings that the National Packages emphasize reducing the cost of green buildings. In developing the National Packages, sustainable products were assessed largely based on cost implications, perhaps because of involvement from the development industry.

Analysts in the United States have also found cost to be a particular concern for smaller and rural jurisdictions (which is not to say that it is not a factor in urban areas) that may lack access to green building products and expertise. Because of the perception that green buildings are more expensive than conventional buildings, researchers have suggested that policy makers should address the issue of cost from the start by trying to win public support for a green building policy.

The introduction of subsidies and financial incentives for green buildings can help remedy some of the cost (or perceived cost) problems. Dutch researchers have encouraged the use of widespread inducements such as subsidies for energy efficiency and tax benefits for green buildings as a way to embed sustainable measures into construction practices. Further, because developers in the Netherlands normally only adhere to minimum required standards for green buildings, incentives could help to introduce more ambitious technologies. Dutch researchers also point out something that has been lacking from the American literature—that sustainable building policies should concentrate not only on building components, but also on the consumption of the people who use the buildings.

The need for flexibility when addressing green building issues is an additional theme of both the Dutch and American literatures. However, in the United States the focus is on the need for flexible building-assessment systems such as those that can be modified for different climate types, while in the Netherlands the target is on the need for flexible policies. Nevertheless, because many assessment methods center on building products rather than on end goals, they can be difficult to modify for local conditions. Some degree of flexibility is built into the Dutch National Packages that allow local governments to choose the measures most appropriate for them and to enact stricter or more comprehensive green building requirements.

The Dutch have found that relying on voluntary green building labeling systems—the major approach in the United States—does not result in the construction of a large number of green buildings. Similarly,

American analysts have reported that voluntary green building programs are not widely used by developers.

Effectiveness

Researchers in the Netherlands argue that because the National Packages contain primarily low-cost green building measures (e.g., energy-efficient light fixtures) the policies do not result in substantial environmental benefits. More ambitious outcomes require more expensive measures that deal with, for example, siting and growth management. A similar criticism exists in the United States where researchers have found that developers practice "points chasing," a process that entails seeking the greatest number of points under assessment systems for the least cost, regardless of environmental benefit. For example, the LEED system for new construction (Version 2.2) awards one point for reusing most of an existing building (which can be very costly) and one point for using low-emission paint (which is much less expensive).

Dutch researchers argue that the National Packages lack an ambitious vision because they were developed to give buildings a sustainable label as inexpensively as possible. Therefore, they represent only incremental change—not major revisions to how buildings are developed. This is not unlike the situation in the United States where developers use voluntary green building labeling systems to market and promote their projects. Furthermore, in both the Netherlands and the United States it is easier to target environmental policies to government buildings than to private individuals.

Green buildings have been difficult to define because of the myriad issues that they can encompass. Also, as green buildings have begun to be redefined as sustainable buildings, their scope has grown from including just environmental issues to economic and social issues, at least in some circumstances. The ambiguous concept of green buildings has led to some breakdowns in both countries, such as enacting policies that are very difficult to implement. On one hand, the complexity of defining exactly what a green building is gives policy makers, developers, and others a convenient excuse for policy failures. Researchers have found that the lack of a shared vision and clear goals for green buildings has lead to stagnation in the technological development of green building products. On the other hand, this ambiguity limits conflict and promotes consensus on green building issues.

Conclusion

Despite the many differences in policy, social, and environmental contexts in the Netherlands and the United States, such as the acceptance of more control over building issues by the national government in the Dutch setting, this analysis has demonstrated many similarities in green building policy research. Still, due to the long history of action on green buildings in the Netherlands, many differences remain from which Americans can derive some useful lessons. From this analysis, I offer several conclusions.

First, the Dutch experience suggests that planners and policy makers in the United States should be very careful about how green building policies develop. Green building policies, like most other policies, exhibit path dependency in the sense that current decisions are affected by past decisions that may not even be relevant anymore. For example, if buildings are assessed based on inputs (building products) instead of on outputs (building performance), that paradigm is very difficult to change once it has been incorporated into normal construction and planning practices.

Second, flexible policies and systems are needed for assessing buildings in the United States. Flexibility will foster more place-based approaches to green buildings and such adaptability is very important for a large and diverse country. For example, requiring a building to use solar energy in a low sunlight location would not be appropriate. Flexibility can also allow for innovation in building technology and design because it can embed ways to modify building assessments and policies as new products and techniques enter the market. Flexibility can also perhaps make green building polices more politically palatable in the United States—especially if the policies originate at the municipal level as such an approach would give local developers more input.

Third, guidance on and attention to the issue of green buildings at the national level is something that the United States can borrow from the Dutch. Despite significant differences in political context, a higher degree of federal facilitation in the United States is practical. A federal-led discussion of green building polices—and federal programs such as grants and tax incentives—could help to foster more state and municipal acceptance. For example, the federal government could assist states and municipalities that are struggling to determine the best way to assess buildings and a federal research and education agenda could help spur innovation. In addition, some of the barriers to implementing green building policies in the United States include concerns about cost and a lack of information and these are issues that the federal government could effectively address

Fourth, the development of green building policies needs to be based on broad and open discussions and negotiations among government and the devel-

opment industry. In addition, green building policies should be approached holistically, in terms of the types of buildings targeted and the environmental and sustainability focus (such as water, energy, air, and other issues). Although green buildings have commonly been associated with energy efficiency and climate-change mitigation, they have many other potential uses, such as in comprehensive planning, watershed management, and other environmental programs. Encouraging the construction of green buildings from within the context of larger sustainability plans (including the issue of climate protection) can help them to realize greater potential.

Finally, there is a need to create capacity for constant innovation in terms of technology and construction practice into green building policies. Policy innovation is also important because programs that remain stagnant will quickly become outdated due to the quick pace of technological change. Because jurisdictions in the United States are new at developing policies for green buildings, they have the opportunity to embed future innovation into the policy structure. For example, policies that require a revisiting of required construction practices over time could allow for the incorporation of new tools and techniques.

In sum, Dutch experience in developing green building policies offers some valuable lessons for the United States. The long history of interest and action in the Netherlands on this front means that the country has gone been through the difficult process of trial-and-error that is necessary for any developing policy system. By looking abroad, planners and policy makers in the United Stated may be able to formulate a very innovative green building policy system and avoid some of the pitfalls that have been experienced elsewhere.

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Appendix A: literature used in metasynthesis

Name of Study	Author Affiliation (number of authors)					Data Collection
	Netherlands	United Kingdom	Brazil	United States	Canada	
Dutch Literature						
Ang et al. 2005	3					case study
Boonstra, 2000	2					case study
Bossink, 2007	1					case study
Bossink, 2002	1					interviews, case study
van Bueren, 2007	2					case study, literature review
van Bueren & ten Heuvelhof, 2005	2					case study
van Hal, 2007	1					focus group, case study, interviews
Hargreaves et al. 1998	2	2				energy use model, case study
Itard, 2007	2					case study, life cycle analysis
Keijzers, 2000	1					case study
Martens & Spaargaren, 2005	2					case study
Melchert, 2007			1			case study
Oostrom, 2001	1					case study
Priemus, 1999	1					case study
Sunikka, 2003	1					case study
Sunikka, 2006	1					case study
Sunikka & Boon, 2003	2					case study, survey
U.S. Literature						
Garde, 2009				1		survey, interviews
Theaker & Cole, 2001					2	case study
Retzlaff, 2009				1		survey
Retzlaff, 2008				1		content analysis

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COMMUNITY ESSAY

Toward greater ecological intelligence in the United States: ten statements with statistics and commentary regarding ecolabels

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Author's Personal Statement:

Those of us whose careers and personal lives focus on environmental issues do not want to admit any deficiency in ecological intelligence. Unfortunately, we have to face facts, and that includes me, which is part of the reason for writing this essay. Insufficient ecological intelligence results partly because of the phenomenon of information overload, but it is also due to the absence of systems, policies, or sometimes even intentions to make certain pieces of information open and public. Ecolabels are one way to remedy these problems. My own experience with the United States Green Building Council's green building rating system (Leadership in Energy and Environmental Design) and its success as a tool for transforming the building sector has demonstrated that these labeling programs can create massive market change. This essay aims 1) to pull together in one place a wide variety of statistics related to ecological intelligence, 2) to distill ten statements worth consideration regarding ecolabels, and 3) to advance a discussion on the trends, potential, and limitations of ecolabels in order to make doing the right thing by the environment and our health, for both individuals and organizations, much easier than it is now.

Introduction

Ecolabels offer a way to address today's most challenging global environmental problems by relying on transparency to build awareness and to change market behavior. Individuals, as consumers and citizens, are becoming increasingly aware of the environmental and social impacts of their purchase decisions and many of them are struggling with how to decide on the "greenest" choices (Bostrom & Klintman, 2008). Ecolabels can help to channel this motivation into action. In the years since the Blue Angel ecolabel was created in Germany in 1977, such labels have become widespread policy instruments for governments, nonprofit groups, and industry associations as means to create competitive advantage for businesses.

While this essay focuses on the United States, many ecolabel programs exist around the world (EUROPA, 2009; ABNT EcoLabel, 2010; AENOR, 2010; CENIA, 2010; Japan Environment Association, 2010; Nordic Swan, 2010; Umweltzeichen, 2010). A great deal has been written about their potential benefits, for example, to stimulate market transformation (Global Ecolabelling Network, 2004; Loureiro & Lotade, 2005; Parikka-Alhola, 2008; Goleman, 2009); potential problems, such as a lack of correlation among varying tiers of ecolabel certification and the expected degree of environmental responsibility (Nimon & Beghin, 1999; Dosi & Moretto, 2001; Rotherman, 2004; Wedding & Crawford-Brown, 2007; Bounds, 2009; Goleman, 2009); and qualities for success, such as being transparent, consensus-driven, and scientifically based (Bostrom & Klintman, 2008; Wedding & Crawford-Brown, 2008; Bleda & Valente, 2009; Grolleau et al. 2009; Thrane et al. 2009; Vermeer & Michalko, 2009).

The most well-known ecolabels in the United States are currently ENERGY STAR and Green Seal (TerraChoice, 2009), while other recognized ecolabels include the United States Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED) designation, the United States Department of Agriculture's (USDA) National Organic Program, the Marine Stewardship Council's Certified Sustainable Seafood label, and the Forest Stewardship Council's ecolabel program for sustainable forest management. Each of these labels has perhaps received disproportionate positive attention due to documentation of the environmental benefits or impact reduction that they have helped to catalyze (Agnew et al. 2006; USEPA, 2008; Forest Stewardship Council, 2009; Watson, 2009; USDA, 2010). However, most Americans have probably not heard of the vast majority of the 325-plus ecolabels that are now used on a worldwide basis (Ecolabelling.org, 2010).

So what? On one hand, this sounds like an opportunity–a chance to fill a void and to bring new programs and brands to consumer markets that, if informed about what to do and how to do it, appear to be increasingly receptive to acting on behalf of the

environment. On the other hand, the lack of understanding of most ecolabels might be cause for concern regarding the possibility of unintentionally creating an ecolabel market that 1) overpromises and underdelivers; 2) leads to more confusion than education; and/or 3) dilutes well-crafted and authentic ecolabels. Moreover, because of their relatively attractive benefit-to-cost ratio, ecolabels may provide an attractive alternative in countries made frugal by the financial crisis that began in 2008. The following discussion seeks to place these issues into bold relief.

Ten Statements, Example Statistics, and Commentary Regarding Ecolabels

The ten statements below, with supporting statistics and commentary, illustrate that it is now time to fill this market need and to resolve confusion by crafting effective ecolabel programs that build our collective and individual ecological intelligence and help to catalyze consumer-driven environmental stewardship.

1. ***Statement:*** We need ecolabels for a variety of reasons.

Example Statistic: The 104,000 human-made chemicals in use today mix in our environment and in our bodies, where they can combine to create over 3 billion potential combinations (Greenpeace, 2006; Goleman, 2009). Only a minute fraction of these chemicals or their mixtures have been studied for potential negative health and environmental effects (Goleman, 2009; USEPA, 2009a).

Commentary: This statistic highlights just one reason why we need ecolabels, at the very least in a cautionary sense. A great deal is unknown regarding the health impacts of the products that we use every day. The other driver for ecolabels is perhaps the more obvious–we are using more natural resources than the planet can regenerate each year (EEA, 2005). Plus, the rate of consumption in the United States and other industrialized nations is many times greater than it is in developing countries (Ewing et al. 2009). This means that we have at least three reasons for needing the easily digestable and ubiquitous consumer education that ecolabels can provide: 1) human health, 2) environmental quality, and 3) global social equity.

2. ***Statement:*** Consumers care about health and environmental quality.

Example Statistic: In a survey conducted in June 2009, 83% of 923 American respondents said that a company's sustainability commitments were "very important" or "somewhat important" in their buying decisions (CapStrat, 2009).

Commentary: It is true that consumer polls can say one thing today and another tomorrow depending on who is surveyed and who is doing the surveying (although the one cited above is reputable). However, other research and polling data have validated this general attitude toward sustainability (Esty & Winston, 2009). In brief, a small percentage of consumers, in the range of 10–15%, seem inclined to pay more for environmentally friendly products or to go out of their way to obtain them (Goleman, 2009). These early adopters are a logical target for ecolabels, but the real goal of such programs is to reach the larger middle section of the market. This segment, perhaps 60–70% of the general American consumer market, could likely be motivated to purchase green products if clear, concise labels made it easy for them and if the products did not cost more (Goleman, 2009). Part of the challenge of making these purchases more convenient is to provide clarity about what constitutes the appropriate consumer choice from an environmental perspective, though often the results of calculation methods–such as life cycle analysis–that are behind some ecolabels can leave considerable ambiguity regarding, for example, the true sources and boundaries of environmental and health impacts (Malin, 2002; Khasreen et al. 2009).

3. ***Statement:*** Consumer decisions drive the American economy.

Example Statistic: Consumer spending accounts for roughly 70% of the gross domestic product (GDP) of the United States.

Commentary: For better or worse, our spending habits fuel our economy. Viewed in a positive light, the trick is to harness this powerful force to change the current trajectory of natural resource overconsumption. More importantly, it allows each of us to vote with our dollars and to take some responsibility for the environmental legacy we are leaving for future generations.

4. ***Statement:*** Big commercial players also want ecolabels.

Example Statistic: Wal-Mart, with fiscal year 2009 sales of US$401 billion (Wal-Mart, 2009), has announced its new Sustainable Product Initiative (Greenbiz.com, 2009a) which, as a first step, will ask its 100,000 suppliers worldwide to answer fifteen

questions on the sustainability of their operations, supply chains, and products.

Commentary: It is important to keep in mind that this is likely just a first step. Wal-Mart has not said that it will stop doing business with suppliers that do not measure up in their sustainability efforts, but this certainly could happen for future contracts.[1] And Wal-Mart, though the 800-pound gorilla, is not unique in its growing efforts toward environmental sustainability.[2] In fact, 76% of the largest firms in the United States, more than double the number in 2006, have reported sustainability efforts and commitments that exceed what is required by law (GreenerBuildings.com, 2009).

5. ***Statement:*** Large public institutions are making environmentally friendly consumerism a priority.

Example Statistic: Institutional purchasers–including the US$700 billion of purchasing power represented by state and local governments, colleges, and universities (Responsible Purchasing Network, 2009) plus the US$350 billion in purchases made annually by the federal government (USEPA, 2009b)–are increasing environmentally responsible purchasing policies.

Commentary: Governments and nonprofit organizations, just like for-profit organizations, are all taking big strides toward environmentally responsible practices. And they are doing it for the same reason–an increasing percentage of their stakeholders want them to do so. Only time will tell which of these sectors will lead, but their efforts are surely synergistic. As one example, consider what happens to the price of green building products and services when the federal government's General Services Administration, the nation's largest owner of real estate, decides to make all of its facilities comply with the LEED green building certification system. (Hint: The prices do not go up.) Associations like the Responsible Purchasers Network are making these environmentally preferable purchases easier and more systematic for institutional players.

6. ***Statement:*** Real estate presents a great opportunity for ecolabeling.

Example Statistic: By 2030, estimates suggest that 50% of the buildings in the United States will have been built after the year 2000 (Nelson, 2004).

Commentary: While this Brookings Institution analysis is a few years old, it is shocking even if off by 20%–30% (because of the myriad assumptions underlying such estimates as well the impacts of the financial crisis that began in 2008). With the American population expected to grow from approximately 300 million today to almost 400 million by 2050 (United States Census Bureau, 2009), we are going to need some new buildings and substantial retrofitting of older ones. In doing so, let us hope that we have high quality ecolabel programs that ensure that our building stock in 2030 is far more energy efficient, high performing, and healthy for occupants than is the case today. The USGBC's LEED green building program is one ecolabel that is helping to guide the market toward lower carbon, healthier buildings. As one indicator that it is doing its job, consider that the green building market in the United States, estimated to be at US$10 billion back in 2005, is expected to grow to as much as US$140 billion by 2013 (McGraw-Hill Construction, 2008). Again, these numbers do not reflect the full impact of the ongoing financial crisis, but even when accounting for this situation, the observed and projected growth is noteworthy.

7. ***Statement:*** Awareness can change behavior.

Example Statistic: A 2009 pilot test of smart grid systems in 100 homes and businesses in the United States resulted in an average of 15% energy savings, with some utility bills down 40% (Greenbiz.com, 2009b).

Commentary: While smart grid applications are not exactly the same as ecolabel programs, both function in a similar manner by raising consumer or user awareness to drive behavior change, whether it is the setting on a thermostat, the type of laundry detergent used, or the kind of house purchased. The key point illustrated here is that transparency can be a much cheaper means to an end than, for example, more capital-intensive building systems or materials. Additional costs are not always necessary for environmentally superior products, but even before having that discussion, there are many ways to invest

[1] Much has been written about Wal-Mart's Sustainability Index and long-range plan "to roll out a universally adopted rating system for the retail industry, the Sustainable Index, which assesses suppliers based on environmental and social criteria. Wal-Mart is starting with fifteen questions for its suppliers, crafted in collaboration with thought leaders in academia" (Cheung, 2009).

[2] Note the specific focus on environmental sustainability in Wal-Mart's recent efforts. While these initiatives may catalyze large, industry-wide changes to reduce environmental impacts, critics still point out concerns regarding Wal-Mart's potential negative impacts regarding social and/or economic sustainability (e.g., impacts on small local businesses and historic downtowns, insufficient health care coverage or wages).

less capital in systems to raise awareness and to deliver environmental benefits.

8. ***Statement****:* Awareness does not always change behavior.

Example Statistic*:* Standardized nutrition labels have been on food products in the United States for twenty years, yet more than 25% of the population in 32 states is obese (US CDC, 2009).

Commentary: Like it or not, people and organizations move with an inertia powered by convenience and an intolerance for extra commitments of time and mental processing. This statistic could simply be an example of our desire to do what we have always done–to eat what we have always eaten, and to drink what we have always drunk. Of course, the more complete answer is that it is the result of many other factors, such as increases in suburban sprawl, growing reliance on automobiles, lack of nutrition education, and intense marketing of foods with low nutritional value. However, it is worth asking whether current nutrition labels, though standardized and well recognized, properly and most easily communicate what buyers need to know. For example, how does a hurried shopper do the mental math to balance the numbers listed among the various categories–fat, sodium, sugar, vitamins, and so forth? Clearly, one lesson for ecolabels is to eliminate this mental homework by making the right choice as easy as pushing a button.

9. ***Statement****:* Greenwashing can erode the power of ecolabels.

Example Statistic: According to a survey conducted by TerraChoice (2009), a North American environmental marketing agency, 98% of 2,219 products reviewed were guilty of greenwashing. Moreover, the number of purportedly green products per store nearly doubled between 2007 and 2008, while green advertising almost tripled between 2006 and 2008 (TerraChoice, 2009).

Commentary: For the last two years, TerraChoice's reports on greenwashing–the accidental or intentional inaccuracies in a product's environmental claims–say the same things: More and more products are using "green" to try to obtain a competitive advantage and almost all of them are not doing it properly. For example, consumer products claiming to be "CFC-free" are guilty of greenwashing because chlorofluorocarbons have been banned in the United States for years. The big concern here has to do with a potential consumer backlash. While the types of consumers that shop at Whole Foods and buy the Toyota Prius may show some forgiveness to a market where companies sometimes commit some "sins" of greenwashing, the mainstream consumers, who really matter, may not be so understanding and patient.

10. Statement*:* Labels must demonstrate excellence.

Example Statistic*:* More than 60% of products in certain categories have earned the ENERGY STAR label, the most well known ecolabel in the United States (Vestel, 2009).

Commentary*:* While ecolabels are a good idea, they also must develop into well-run programs. This means, for example, that only the best-in-class products should receive recognition and that checks and balances should be in place to prevent any conflicts of interest between the regulators and the regulated. We need to know that a green seal of approval means what it is supposed to mean. Again, the more that consumers are intentionally or accidentally "tricked" into doing what we think helps the environment, when we may just be buying status quo products, the more likely it is that we will stop concerning ourselves with ecolabels and perhaps environmental education programs generally.

In conclusion, this essay has used ten high-level statements, with select statistics and commentary, to illustrate that ecolabels can contribute to a variety of goals, including those focused on the promotion of human health (e.g., transparency regarding potential toxins in the products we use every day), the environment (e.g., guidance on more environmentally responsible building choices), and the economy (e.g., market differentiation and brand enhancement via efforts like Wal-Mart's Sustainability Index). Most importantly, ecolabels can harness some of the most powerful forces in the United States–consumer, business, and institutional spending–to serve as a force for good rather than continuing to facilitate overconsumption and waste. However, the sponsors of ecolabel programs may encounter difficulties in raising public awareness to sufficiently high levels to change consumer behavior and in ensuring that only products demonstrating excellence above business as usual receive certification. Future research should focus on 1) defining the criteria and processes with which to gauge the quality of ecolabels and the organizations that create and manage them and 2) assessing the effectiveness of various ecolabels and the determinants of their success.

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BOOK REVIEW PERSPECTIVES

Michael Egan, *Barry Commoner and the Science of Survival: The Remaking of American Environmentalism*

MIT Press, 2007, 320pp, ISBN: 0262050862

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Michael Egan has done an important service for mainstream environmental advocates who know little about the life's work and uncommon mind of Barry Commoner, biologist, radical activist, unapologetic socialist, democratic idealist. Egan also has done an important service for scholars in the interdisciplinary field of science and technology studies (STS)–a key component of contemporary sustainability science–few of whom, it seems, have seriously examined Commoner's political philosophy of environment and technology, his impact on twentieth century environmental activism, and his model of politically engaged scientific expertise.

Egan provides a fascinating and ultimately somewhat depressing account of what he calls Commoner's "novel apparatus" of activist, democratic science. It holds that scientists have three obligations: to vigorously dissent when science is mobilized in ways that harm the Earth's support systems and human well being; to disseminate scientific information in a form that can readily be understood by the public; and to facilitate and encourage active public engagement in deliberation on technological and environmental risk.

Early in the book, Egan gives a systematic account of Commoner's remarkable deployment of this apparatus in tirelessly focusing public and scientific attention on the health threat posed by mid-twentieth century atmospheric testing of nuclear weapons. Commoner mobilized scientific dissent, fed the public crucial data that documented the risks posed by fallout, and mobilized even children to oppose the threat. The biography demonstrates that the biologist's intensive efforts via a succession of high-profile scientific committees and panels–several of which he had a hand in creating–were crucial in documenting the weapons' environmental implications and creating a groundswell of concern that prompted the 1963 Nuclear Test Ban Treaty.

In the wake of that victory, Commoner (along with Rachel Carson, whose *Silent Spring* was published in 1962) emerged as one of the most recognizable faces of the Age of Ecology. Egan, who conducted numerous interviews and combed Commoner's papers in the Library of Congress, relentlessly documents the biologist's path to the cover of *Time* magazine in 1970, the marginalization of his ideas during the first Earth Day, and his damaging battle with Paul Ehrlich over the significance of population growth as a factor in environmental degradation in the early 1970s. (Commoner argued it was not population growth per se, but "polluting technologies and the free market that produced them [that] caused the…crisis," Egan writes.) The book continues with Commoner's struggle to convince the American public to confront overconsumption and to move toward democratic socialism in the mid-1970s and his ineffective effort to forge a coalition of the poor, minorities, and workers during a bid for the presidency in 1980.

If Commoner's success was muted in this second phase of his public career, *Barry Commoner and the Science of Survival* suggests it was even more muted in the third, post-1980 phase. And as Egan shows Commoner's influence diminishing, or at least becoming less direct, the book's historiographic strategy becomes somewhat oblique. It locates Commoner's ideas in the context of the evolving environmental movement of the 1980s and beyond–often revealing these ideas to be prescient–but rarely shows them directly influencing the evolution of even the grassroots toxics and environmental justice movements. Here the book more nearly offers a conceptual history of the movement juxtaposed with Commoner's scientific vision and political vision than a history of the biologist's practical role. And, in some respects, Egan's narrative seems oddly detached from one of the main features of the broad movement's history during this era: its struggle to cope with the technocratic antienvironmental backlash that began under Reagan and has continued in numerous guises ever since (Vig & Kraft, 2010). (Tellingly, Reagan's name appears only once in the book's index and once in its 49 pages of endnotes.)

We see Commoner's Center for the Biology of Natural Systems concentrating on solid waste incinerators and the exquisitely toxic class of substances known as dioxins, but his connections with and influence on the grassroots-toxics movement that led the public fight against incineration and dioxin never quite come into focus. (This includes his influence on one of the movement's architects, Peter Montague, whose long labor in making environmental science accessible to lay people–as Commoner prescribes–is legendary. Egan cites Montague's work extensively, but, surprisingly, not his dissertation on Commoner and Ralph Nader.) We see Commoner speaking about the endocrine-disrupting effects of substances like dioxin, but it never becomes clear just what role he had in the mobilization to document and publicize these effects and force the hand of government agencies inclined to study rather than regulate them (see Krimsky, 2000). We see Commoner focusing on industrial pollutants' infiltration into the human body (a theme he had pursued since the days of atmospheric nuclear testing), but whatever role he might have had in the blossoming of movement concern about "body burden" in the 1990s and early 2000s (e.g., Houlihan et al. 2003) remains fuzzy. We see Commoner arguing extensively that the poor and racial minorities are disproportionately exposed to industrial contamination (a theme for him since the 1960s), and applauding the emergence of the environmental justice movement, but his relationship with that movement in the 1980s and 1990s is never sharply defined.

The oblique character of Egan's account of this period is illustrated by his approach to Commoner's support for a major tenet of the grassroots environmental movement in the United States: the precautionary principle. Egan convincingly shows Commoner to have had a strong precautionary impulse throughout his career. He quotes the biologist arguing in 1966, in reference to DDT and other synthetic substances, that "we have risked these hazards before we knew what harm they might do." In a speech that year, Commoner said:

> [The] record shows that we do not yet understand the environment well enough to make new intrusions on it, on the large scale that is now possible, with any reasonable expectation of accurately predicting the consequences...Pollution by detergents, pesticides, herbicides, radioisotopes, and smog...represents a blind intrusion into aspects of the complex biology of the environment which are still poorly understood. Apart from their known hazards these pollutants represent a huge gamble.

Egan shows Commoner making distinctly precautionary statements about thalidomide in the 1960s, genetic engineering in the 1980s, and incineration in the 1990s. Despite the prominence of the precautionary principle in American environmental debate since the 1980s, however, Egan points explicitly to it only once in the text and once in a note, both times demonstrating that Commoner's sensibility resonates with the principle but without specifying whether he endorsed or campaigned for it.

Consider, too, that Egan's account of Commoner's views on risk deliberation, the third leg of his apparatus, is something of a muddle. Egan assures us that Commoner rejected technocratic assessment of risks: "Calculating risks...was not an equation that could be concocted by experts, but rather a question of social values and ethics that required far greater public participation." But the picture of Commoner's perspective frequently drifts toward the technocratic, as when Egan quotes Commoner's 1966 book, *Science and Survival*, on the hazards of synthetic pesticides in the Mississippi River: "The only feasible way to judge the significance of this contamination is to estimate the risks, compare them with the benefits...and strike a balance...that will be acceptable to the public." This is some distance from active public engagement in risk deliberation (cf. Fischer, 2000). Egan never quite shows Commoner distinguishing it from the grotesquely technocratic package of "acceptable risk" principle plus expert quantitative risk assessment plus expert cost-benefit analysis that came to dominate government regulation of industrial chemicals in the 1980s.

Given how provocatively Commoner's "apparatus" represents central concerns of STS–the thoroughly social character of science and technology–it is remarkable how infrequently scholars working in this area have examined his efforts and mobilized his ideas.

Egan's rich biography sent me thumbing through the indexes of books on my shelves. Commoner's ideas had long struck me as paralleling some of the best, most progressive thinking in STS. Feenberg (1999) has grappled extensively with Commoner, but I realized I did not know how Commoner's writings have been reflected in–and have inflected–the broader STS literature. Remarkably little, it would seem.

Commoner's understanding of the urgent need for vigorously democratic means of steering industrial technology resonates deeply with pivotal works of Winner (1978), Morone & Woodhouse (1986), Sclove (1995), Sarewitz (1996), and Kleinman (2000), yet I could not remember seeing these scholars offer him as an exemplar, or examine his cam-

paigns as case studies, or draw on his ideas. Perusing indexes, I now realized that only one of these books–Morone & Woodhouse's *Averting Catastrophe*–gives Commoner a nod (and then but a single sentence citing the biologist's lament about the seemingly suicidal bent of Western society's technological development). Or perhaps Fischer's (1990) and Martin's (1996) investigations of the often corrosive, antidemocratic politics of scientific and technical expertise tap into a career that, in Egan's words, "sought to reconnect professionalized science with the public interest"? Here again, surprisingly, the indexes do not whisper Commoner's name. Or perhaps Collingridge (1980) and Perrow's (1984) treatises on the characteristics of technosocial systems vulnerable to catastrophic failure? No.

I turned to the ISI Web of Science to see how often Commoner's work is cited in peer-reviewed STS literatures. Post-normal science theory, which sees major environmental issues as requiring lay participation in science? It turns out that nine articles citing Funtowicz & Ravetz's work (e.g., 1993) also reference Commoner's (e.g., Cohen, 1997). Precautionary principle? Of more than 1,000 hits on the term, only five cite Commoner. Public ecology? None of the articles citing Robertson & Hull's seminal work (2001; 2003) also cite Commoner. Or activism and science studies? None of the articles citing Woodhouse et al. (2002) cite Commoner. Even the broadest nets provide paltry returns: As of October 2009, Commoner had been cited only seven times in *Bulletin of Science, Technology, and Society* and four times in *Social Studies of Science*. Remarkably, he has never been cited in *Science, Technology, and Human Values.*

Egan is certainly correct that "Commoner influenced the direction of the modern environmental movement and helped foster its sophisticated concern for public health and the human body as an environmental landscape needing protection." But his account ultimately sheds too little light on the nature of the fostering and the degree of influence beyond 1980. Regrettably, Commoner's influence in this period has been a good deal less obvious, less direct, less decisive than I, and, I suspect, Egan, wish it had been. Taking Commoner's social critique and political prescription to heart might have helped give the movement the grit needed to remain coherent, competent, and effective during decades of antienvironmental backlash. Instead, Commoner's message was heard at best only in the movement's margins–in the grassroots toxics and environmental justice movements–and today we are left with what Egan calls "the tragedy of this narrative…the breadth of environmental issues [Commoner] addressed that remain not just historical artifacts but ongoing contemporary problems."

Meanwhile, STS's overall failure to acknowledge or even, seemingly, to care much about Commoner no doubt is in part a function of the field's unfortunate political quiescence (see Martin, 1993; Woodhouse et al. 2002). Commoner's unapologetic socialism and commitment to democratic reconstruction of technology decision making perhaps leave him largely invisible in a field that has come of age in the post-Reagan era and has shown itself preoccupied with *de*construction.

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After the publication of *Barry Commoner and the Science of Survival*, I wrote a short book note for *Chemical Heritage* (2008). In that very brief review, I wrote about the ways in which the story Egan tells helps us to understand the historical roots of the complex relationship between science and activism. When approached this time to review Michael Egan's biography of Barry Commoner, I welcomed the opportunity to engage this work again. My general thoughts have remained the same since my first reading: this is an important book about an important topic and an important person. Admittedly, I knew very little about Commoner before meeting Egan several years ago. Reading the book helped to fill a void in my understanding of Cold War era science. And, in conversation with other recent titles, such as Kelly Moore's *Disrupting Science* (2008), Egan's work begins to offer a foundation on which to understand our recent wrangling with the strange relationships between science, politics, activism, and the environmental movement. It was my thinking in this context that led me to close my note in *Chemical Heritage* with the line, "Egan's telling of the life, science, and politics of Barry Commoner reminds us of a time when scientists could be activists, and science and activism could coexist." I now wonder if this is true (then or now); or, perhaps more accurately, what kind of activism did Commoner's actions engender and what have been the repercussions for our understandings of the ways science and activism ought to interact.

Commoner's core contribution, Egan writes, was the development of a "new apparatus" that attempted to unite science, environment, and democracy to address the emergence of new challenges in the post-World War II United States. Four pillars supported this apparatus: dissent, information, dissemination (of information), and risk. According to Commoner, scientists (as citizens and as agents for democracy) had an obligation to dissent, to challenge conventional thinking. Through dissent, scientists would ply their trade in ways that increased debate. To encourage these debates, scientists ought to seek out (through research) additional pertinent information. The result must then be disseminated to everyday citizens as a way of empowering them with the information and perspectives science offers. Equipped with the power of information, citizens can participate actively in deciding what sorts of risks they might be willing to accept (rather than having that calculation done for them). In more general terms, it is easy to see how this apparatus would strengthen democratic ideals and place new concerns about technology, environment, and health squarely within the purview of a civil society. Citizens, empowered by scientists (who are willing to break with the status quo) with information, become more active, which yields a stronger democracy. It is a lovely picture. But is it possible? And if it is, would we want it?

I am going to ignore for the moment some of the more contextual issues that arise when thinking about scientists in the post-war period and their search for a new role in an atomic age.[1] Rather, I want to focus on information and its dissemination as a tool for strengthening democracy, especially in an age of risk. To switch structural metaphors just a bit, we might consider information the keystone of Commoner's new apparatus. Dissent and participation become more powerful when brought together through information. Commoner, as Egan demonstrates, saw scientists providing this crucial piece through the application of science to pressing social needs and the dissemination of results to audiences broader than the community of peers. The case of atmospheric testing of atomic weapons provided Commoner with an opportunity to experiment with this new apparatus. He sought to equip concerned citizens with enough information about the possible risks associated with testing that they would pull the levers of democracy to halt this practice. His now famous tests for strontium in baby teeth (collected from concerned parents

[1] There are certainly other places to explore these issues. For an overview, see Moore (2008). The more general questions about the role of science and scientists in a democracy have roots in Merton's (1942) essay on the topic and extend through to present debates about what role experts and scientists can/might/ought to play in a functioning democracy (see, e.g., Jasanoff, 1994).

around the country) effectively demonstrated the promises and problems with this approach. Citizens did indeed mobilize when equipped with the information disseminated by Commoner and his colleagues. But these citizens could not simply speak (scientific) truth to power; it turned out power had its own (scientific) truths.

I do not want to argue that Commoner did not understand or even perceive that there would be problems with the application of this apparatus for using science to strengthen democracy. But in taking seriously the subtitle to Egan's book, I want to think critically about how exactly Commoner refashioned environmentalism in this country. According to Egan's telling, Commoner believed that the key to action (whether through dissent or cooperation) came in the form of information. Implicit in this construction, however, is the assumption that scientific information could act as a neutral arbitor; that with it we as citizens could indeed speak truth to power. And yet much of Commoner's career was spent in grand debate with scientists over the very issue of whose science was true and the entangled politics of what each truth might mean. Rather than being resolved, the debates raged on seemingly without end.

Two important interelated results follow from these debates. First, as Moore notes in her study of science and politics in this era, science became a tool to be plied by nonscientists as well. Politicians, too, could draw on the power of an objective science to make truth claims. Second, scientific information became the basis for our thinking about health, the environment, and risk. Regulation became a strictly scientific matter, dedicated largely to three of the four pillars: information, dissemination, and risk calculation. Citizens attempted to become citizen-scientists to better participate in the great debates. Industry, too, noticed what was happening and changed tack. They began fighting fire with fire. "Doubt" became the product of science, not truth. The result has been bureaucratic quagmire in the United States on nearly all important health and environment issues: toxics control and climate change just to name two. The struggle for science to appear politically neutral has only allowed it to be put to use by those with more power.

For those struggling to find new ways to promote action and activism on behalf of exposed communities, endangered environments, or the planet itself, the situation has only become more complicated. In the wake of the "Republican War on Science" scientists have become even more concerned about maintaining images of political neutrality. [2] And as politicians continue to avoid difficult decisions, they keep deferring to science and scientists for help. But risk is not something purely quantitative. There is no calculus for democracy and dissent. And yet with the focus on scientific information that the new apparatus creates, this is precisely the situation we find ourselves in; we are still waiting for the results to know whether or not we should be demanding action about the potentially catastrophic collapse of the world as we know it. So, is *this* what Commoner remade American environmentalism into? And if so, how do we remake it again?

Commoner's role in the construction of the modern American environmental movement is largely unsung. Egan places him squarely within a context that has long missed one of the most important transitions in environmentalism in the United States: the scientization of the movement. Commoner's work helped to create a foundation for the growth of the types of citizen science that have come to play such a crucial role in the larger environmental movement as well as the environmental justice and health movements. But has it also created an environmental movement that perpetuates a disembodied and detached experience of our environment? I cannot help but think of an organization like 350.org in this context, which seeks to draw attention to climate action through the promotion of 350 parts per million of carbon dioxide as the maximum capacity of our atmosphere. I shudder at the idea that all of the things that climate change stands for–rising sea levels, shifting winds, altered biota, changes in the availability of water resources, mass migration–can somehow all be represented by a number: 350. The number, like so much of the science in the environmental movement, flattens the terrain of politics, geographies, economies, and justice. These features cannot be represented in numbers–they are the unquantifiable that have been labeled irrational and therefore unnecessary. I get the sense reading this book that this is not where Commoner intended us to end. Perhaps now we can begin thinking about how to remake the environmental movement again.

About the Author

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[2] See Mooney, 2006.

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Rejoinder from the author

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After World War II, American environmentalism shifted from collective action to protect nature from civilization to a movement whose primary goal was to save civilization. Put another way, the technological advances and new threats to life on Earth that emerged during and immediately after the war challenged American society to recognize that human bodies and human health were ecological landscapes that required protection. By and large, this mentality continues to drive much of the environmental movement into the 21st Century. Its aims are most explicitly visible in efforts to control climate change, concerns about toxics, and activism regarding environmental justice. Even at the grassroots level, scientific information—most of it quite technical—has permeated throughout the activities that drive American environmentalism. The ethics and aesthetics that motivated earlier generations of conservationists and preservationists (an awkward dichotomy) are not wholly absent, but activists have learned that science and scientific authority are the indices for the cognitive mapping of our environmental crisis, and if they are to be heard (and realize change) they must engage with this vocabulary. I submit that Barry Commoner's contributions in making scientific information accessible to public audiences were instrumental in transforming American environmentalism. Some years removed from writing *Barry Commoner and the Science of Survival: The Remaking of American Environmentalism*, I suspect that I would now be more forceful in arguing that this scientific activism is a critical and underappreciated feature of the history of environmentalism and—just as importantly—one of the most significant developments in the history of science since World War II.

As I write, winter is rolling in and snow flurries are swirling off the escarpment visible through my office window. My students are headed in to write a final exam for my undergraduate course on science and technology in world history. I have been stalling on writing my thoughts on Jeff Howard's and Jody Roberts's engaging and incisive comments on my book. My procrastination has a lot to do with the book, Commoner's place in history, their reflections on both, and the difficulties of crafting a response for a journal whose title begins with *Sustainability*. Downstairs, my students are probably cursing my good name as they open their exam booklets, but they serve—indirectly—as the inspiration for my response. Having previously addressed the military-industrial complex, the bomb, and the Cold War's influence on science and engineering, and having stressed the manner in which knowledge reflects the material circumstances of its conception—Thorstein Veblen's astute observation—I felt as though the course needed to conclude with a more cheering suggestion of how science and society interact. My last lecture introduced Commoner's science of survival. Here, I intimated, was science not removed from society, but rather science and scientists firmly entrenched in the real world implications of their work. This was interested science. It is a real facet of the contemporary scientific landscape.

What first interested me about Commoner was his articulate recognition of this turning of science toward social engagement and how he mobilized his political energies to address it. What Commoner identified and cogently communicated was a dynamic shift in the manner in which humans interacted with the physical environment. Whereas the environment had typically been regarded as an infinite diluent for the hazardous products of human activity, the intensity and form of technological activity after World War II put into question the total environment's capacity as an infinite reservoir. From nuclear fallout to the products of the petrochemical industry, the nature of the pollutants threatening the human habitat was altered. "In the past," Commoner wrote in a grant application that would yield inaugural funds to build the Center for the Biology of Natural Systems, "apart from relatively localized inorganic industrial pollutants, human impact on the environment was due almost exclusively to human biology and was represented by the common products of animal excretion: CO_2, nitrogenous wastes, and the concomitant microbial flora" (Commoner, 1965). While these pollutants constituted natural wastes and were subject to biological degradation, the latest synthetic materials were new to the biosphere. This situation constituted a radical transformation in technological systems and, necessarily, an important turning point in how we need to think about nature and sustainability.

One of my enduring regrets with the book is that I did not spend nearly enough time unpackaging the

role and efforts of Commoner's Center for the Biology of Natural Systems. The history of the Center constitutes an important case study for the melding of science and activism, as well as a valuable lens for examining the science of the environmental crisis. In the early 1960s, a congressional act made funds available to the Public Health Service to establish ten centers for research on environmental problems related to human health. In spite of several preceding applications from numerous universities, the Center for the Biology of Natural Systems was the first (and only) center to receive funding before the budget was ultimately eliminated. In September, 1965, Commoner submitted a funding proposal to the Public Health Service for the creation of a scientific research center that would tackle the growing number of environmental threats to human health. Commoner was listed as the principal investigator of a team of St. Louis-based collaborators on the grant, which had a budget of $3.6 million dollars over six years. Collaborators came from Washington University's departments of botany, zoology, physics, and chemistry, and also the university's Medical School, the St. Louis Zoo, and the Missouri Botanical Garden. As Commoner recalled, "The proposal represented a collaboration rather than an individual university-based or discipline-based activity with an elaborate program aimed at the complexities of the natural biological systems in which nature functioned [and that] required the attention of basic scientific research" (Commoner, 2007).

The proposal not only reflected the program's environmental imperatives, but also the importance of public health research in the scientific climate of the time. Such research, the application asserted, was a scientific orphan. The Public Health Service certainly thought so; more to the point, their attempt to develop a comprehensive research program on the environment was something no government agency had attempted. Commoner and his colleagues proposed to connect to the rapidly developing modernization of biological research—including molecularly oriented research—with research in chemistry and physics. In its formation and mission, then, the proposed research was very intentionally multidisciplinary—or, as Commoner insisted, *adisciplinary*, because, he argued, traditional academic disciplines were not independently equipped to tackle environmental problems. During a period when scientific investigations tended toward greater reductionism, the more wide-ranging adisciplinarity of the Center's vision demonstrated a novel reading of the nature of environmental problems. I should stress that this is not ecology, but rather a science of the total environment that resisted being limited to ecological or toxicological methodologies.

The application also outlined the rationale for the center's proposed name. The Center for the Biology of Natural Systems was a deliberate response to the increasing molecularization of the biological sciences, which, Commoner and his colleagues argued, stressed extractive parts of living systems, but not the living systems themselves. "The dependence of human health on the environment is an expression of a basic condition of life," the grant stated, "that every organism functions as part of a natural system which includes other individuals of the same species, a wide variety of other organisms, and their non-living surroundings" (Commoner, 1965). In addition to situating the role of public health within a more traditional environmental rubric, the Center for the Biology of Natural Systems also played a vital role in the larger history of the creation of a public, or vernacular, science after World War II. Commoner and others had already developed a fairly sophisticated vernacular science in their work against fallout from above-ground nuclear weapons testing, but the efforts within the Center constituted a more evolved and accepted branch of this work. If Commoner and others who dissented against the American atomic bomb tests had been outsiders in the late 1950s, Commoner's environmental work in the 1960s, under the guise of the Center for the Biology of Natural Systems, was very much a part of the mainstream, or popular, environmental initiative. This is an important story that deserves further study.

My extended introduction means to assert the motivations that drove much of Commoner's environmental work. While it does not respond directly to a number of Howard's and Roberts' more specific observations, I believe it sets the scene for my remarks below and points to an important moment in the history of sustainability that warrants careful attention. In the remainder of my reflections, I aim to do three things: examine Commoner's place in the literature, consider Commoner's influence after 1980, and address the relationship between science and activism.

Commoner's Place in the Literature

In noting Commoner's relative absence from the historical and social science literature on science and the environment, Jeff Howard identifies a point that provided me with many sleepless nights while working on the book. Why is it the case that Commoner is not cited more frequently? As Howard observes, he certainly ought to be. There are a number of potential explanations for Commoner's relative invisibility:

1. Commoner was not all that important to the larger narrative of science, environment, and activism in the post-World War II period.
2. Commoner was the product of an older generation and an older way of seeing things that resonated less with scholars working at the very end of the twentieth century and the beginning of the twenty-first.
3. For a variety of reasons, Commoner's ideas failed to capture the public and scholarly imagination over the long term.
4. Commoner's politics and his radical, confrontational approach alienated many would-be allies.
5. Commoner never was, and never saw himself, as the kind of public intellectual actively providing a template for thinking about environmental issues in a scholarly format; his interests involved the real world and effecting real change.

I suspect that each of these explanations holds some kernel of truth, though I would be inclined to put much heavier emphasis on the bottom of the list. Commoner's socialism was not popular within many environmental circles of the 1960s, 1970s, or 1980s. While many of his criticisms and positions were warmly received, his radical, leftist politics consistently made him a rank outsider among the more mainstream and liberal-minded leaders of the bigger environmental organizations. This occasionally led to confrontation (best remembered, perhaps, in his bitter dispute over population with Paul Ehrlich), and Commoner was rarely one to back down. More importantly, however, like most scientists involved in environmental politics, Commoner was not terribly interested in social theory, and contributing to it did not appeal. He saw himself as a problem solver, not a paradigm or rule maker. Because he had no interest in engaging with the social science literature, his ideas may have gained less purchase with those scholars during a period when their studies of science were in their initial ascendancy. This is, however, a far from satisfactory answer to an intriguing question. The real answer is: I do not know. Commoner's Four Laws of Ecology are continually invoked, his strong feelings about population and his debate with Paul Ehrlich are occasionally recalled, but little else of his work and efforts are remembered.

Commoner's Influence After 1980

Howard also asks what happened to Commoner after 1980. Following his campaign for the presidency in 1980, his interaction with the environmental movement seems at best peripheral. Understand, first, that by 1980, Commoner was already in his 60s; he retired from Washington University and moved the Center for the Biology of Natural Systems to Queen's College in Flushing, New York. The publication and archival record demonstrate that the move permitted Commoner to actually increase his productivity in terms of urban issues. But my treatment of Commoner suggests a fading from the center of the larger environmental landscape. In the book, I point to the continued importance of his activism and the consistency with which Commoner continued to identify what he saw as the root problems of the environmental crisis. Furthermore, if the focus of American environmentalism had shifted after World War II, its practice changed dramatically upon Ronald Reagan's arrival in the White House in 1980. Personnel changes in all the major environmental organizations brought about a markedly different kind of activism and appealed to a different kind of environmentalist. Lobbying and litigation moved people and priorities to Washington and away from the kinds of grassroots advocacy that Commoner championed. These teams had their own scientists and less interest in local communities; they needed money, not feet in the streets, and their flyers and fundraising reflected those circumstances.

Although Commoner's influence waned after the 1970s, his activity continued unabated. He carried on working with smaller communities on various issues that affected them: dioxin, the siting of waste and power plants, recycling. The world of environmental politics might have altered, but Commoner and his practice changed little. He remained dedicated to the dissemination of accessible scientific information to the publics that needed it. Sticking to his guns in the 1980s, however, now seems justified in light of the rise of environmental justice activism in the 1990s. It would be awkward to assert that Commoner anticipated the environmental justice movement, but even a cursory reading of *The Closing Circle*—not to mention much of Commoner's work before that—shows the importance of social justice and citizen empowerment in environmental activism. While Commoner's work in the 1980s and 1990s did not receive as much mainstream attention as his earlier efforts, his ideas about social justice became distinctly more palpable. And, in accordance with the new environmental justice movement, Commoner's work maintains its grassroots and information-based themes.

Moreover, I do not think I claimed (or certainly did not mean to claim) that Commoner was the apotheosis of American environmentalism since the late 1950s. Far from it. The Jekyll and Hyde nature of this part of my narrative might obscure the bigger efforts of the work, insofar as I remained interested in the trajectory of American environmentalism in the post-World War II landscape, while being curious to see

what would happen if one wrote Commoner centrally into this narrative. What I think emerges in this final chapter is a variety of intersecting and conflicting paths between mainstream and grassroots environmentalism and parallel paths between Commoner's efforts and the movement for environmental justice.

The Relationship Between Science and Activism

Jody Roberts asks the intriguing question: are Commoner's views on encouraging public participation in science actually a good thing? He points to various examples of the democratization of science as having Babelian consequences. Whereas science has traditionally been regarded as an authoritative tool for providing solutions to many knowledge-based problems, it has been less successful in the environmental context because competing interests from local communities, industrial producers, and legislative bodies have introduced and emphasized incommensurable motivations and priorities. This problem preceded the emergence of public interest science, but Roberts suggests that politically engaged scientists like Commoner contributed to the relative cacophony of voices in environmental debates, which ushered in a period of what Silvio Funtowicz & Jerome Ravetz (1992) have called postnormal science, where knowledge is "uncertain, values in dispute, stakes high and decisions urgent." Postnormal science reflected the new nature of scientific inputs to policy processes.

Looking at the bigger picture, scientific communities have been pressed into action to weigh in—quickly—on the issues of the day, from nuclear fallout to global warming. And let me stress "quickly;" the project of this postnormal science—a derivative of Thomas Kuhn's paradigm-based normal science—is not to collect and present definitive knowledge, but rather to function within a highly complex network of policy-making interests.

In an important 1985 article on the development of conservation biology, Michael Soulé discussed the precarious nature of what he called "crisis disciplines," where, he claims, "one must act before knowing all the facts." According to Soulé, conservation biology is one of these disciplines. And this is telling. He writes: "crisis disciplines" require more than "just science." In fact, they are "a mixture of science and art, and their pursuit requires intuition as well as information" (Soulé, 1985). And this can be problematic. For example, the quality assurance pivotal to the success of the scientific enterprise now demands an extended peer community consisting not just of experts, but of all stakeholders. In addition, in the new, postnormal science, scientific findings constitute only one kind of evidence; traditional, empirical results are married with local knowledges, community surveys, leaked documents, and investigative journalism.

As I understand it, this is the problem Roberts identifies with Commoner's position. And it's a valid concern. But what are the alternatives? As Brian Wynne & Sue Mayer (1993) correctly assert: "Where the environment is at risk, there is no clear-cut boundary between science and policy." One of Commoner's most strongly held beliefs was the notion that scientific experts had no moral authority to determine what constituted acceptable risk to a larger public. That was a policy issue and one that required the input and participation of an informed public. But that is not usually/ever what happens. Rather, Ravetz (1999) observes a curious inversion of the dependence on "hard," objective scientific facts and "soft," subjective value judgments: "All too often, we must make hard policy decisions where our only scientific inputs are irremediably soft." In that context, works such as Chandra Mukerji's (1989) *A Fragile Power: Scientists and the State* identify an ominous and complex interdependence, wherein scientists assume the role of highly skilled experts retained to provide legitimacy to government policies.

This is what the more idealistic motivations behind the science information movement were railing against and why Commoner and others worked to provide citizens with the technical information necessary for informed public participation in debates over environmental problems. If science and policy are inextricably linked, then the public needs to be involved. To Funtowicz & Ravetz (1992), this is the only way science can be redeemed in the public spotlight; postnormal science is the lone portal through which trust in science—deeply eroded by the atomic bomb, the array of toxic pollutants that infiltrated the physical environment since World War II, and the rampant capture of science by globalization—can be restored. Moreover, the increasing dependence on "soft" scientific knowledge raises some intriguing social questions about uncertainty and scientific authority. To some, this might actually be a good thing. Indeed, Ulrich Beck raises a potential boon for scientific uncertainty. "The exposure of scientific uncertainty," he writes, "is the liberation of politics, law, and the public sphere from their patronization by technocracy" (Beck, 1992).

Public science has and will continue to foster greater scientific literacy and a more informed public. My interest here and in the book is not to pass judgment on the moral nature of postnormal science, but rather to recognize its mechanisms as a prevalent feature of the American scientific landscape after World War II and to examine Commoner's historical significance within that context. The complexity inherent in environmental disputes since World War II

rested on the uncertainty and controversy surrounding the science designed to resolve disagreements. Commoner's historical significance stems precisely from his early recognition of the importance of translating or conveying that uncertainty to the public as essential in assuring continued public participation in environmental issues.

In Roberts' rereading, science is necessarily a top-down venture, which requires a more centralized authority to avoid the noise of too many dissenting viewpoints. For the reasons noted above, Commoner would resist this claim, and so would I. While engineering requires this kind of central control, science and the growth of scientific knowledge have historically flourished in periods and places where fewer impositions influenced its progress. Going back into ancient history, the Ionian Coast exhibited a kind of openness and tolerance that encouraged the flow of ideas. Similarly, much of the creative work during the Scientific Revolution was the product of intellectuals working in collaboration, but removed from the political upheavals of their day. The close working relationship between science and policy to which Roberts alludes is a fairly recent development, which can be effectively traced to World War II and the American government's growing investment in research and development (Egan, 2007). Commoner would be quick to note that this relationship is what caused the environmental crisis and is hardly the way to solve it. He concluded *The Closing Circle* with this astute observation: "sweeping social change can be designed only in the workshop of rational, informed, collective social action" (Commoner, 1971). More on this in my concluding remarks.

I would also challenge a number of Roberts' contentions concerning Commoner's intents and actions. Firstly, while Commoner was an experienced political animal and relished debate, I do not think he (much less my book) spent inordinate amounts of time in conflict with other scientists. Commoner butted heads with a number of prominent figures and frequently refused to back down (he called it "principled arrogance"), but these are largely side notes to his career and activism, not their core.

Further, I doubt Commoner's advocacy of scientific information as a neutral arbiter was any more than a rhetorical flourish; he was very conscious of how science and expertise implied a level of social authority and sought to use that notion as an empowering tool for a confused and scared public. His bigger intent was to generate broader interest and action. Roberts refers to my discussion of the Baby Tooth Survey that analyzed deciduous teeth in the St. Louis area for strontium-90 as a method of determining the risks inherent in aboveground nuclear weapons testing (Egan, 2007). Citizens did mobilize. A nuclear test ban treaty was brought about, in large part, by the pressure that concerned citizens imposed on governments. But there was also something else. The generation of children born during the 1950s, those whose teeth served as the materials for the baby tooth survey, became the most environmentally engaged generation in American history. I do not mean to pretend that Commoner's activism fostered this (and I certainly could not prove it), but during the 1960s, 1970s, and 1980s, scientific knowledge played an ever-increasing role in environmental debates and the public followed along more avidly than they had before.

In closing, let me draw from Steven Shapin & Simon Schaffer's (1985) seminal text on natural philosophy in the Scientific Revolution, *Leviathan and the Air Pump: Hobbes, Boyle, and the Experimental Life*, the publication date of which 1985 coincides neatly with the decline of Commoner's influence:

> Now we live in a less certain age. We are no longer so sure that traditional characterizations of how science proceeds adequately describe its reality…Our present-day problems of defining our knowledge, our society, and the relationships between them centre on…dichotomies between the public and the private, [and] between authority and expertise…We regard our scientific knowledge as open and accessible in principle, but the public does not understand it. Scientific journals are in our public libraries, but they are written in a language alien to the citizenry. We say that our laboratories constitute some of our most open professional spaces, yet the public does not enter them. Our society is said to be democratic, but the public cannot call to account what they cannot comprehend. A form of knowledge that is the most open in principle has become the most closed in practice. To entertain these doubts about our science is to question the constitution of our society.

Barry Commoner spent a career reveling in questioning the constitution of our society, and the larger science information movement saw as its guiding principle an approach to breaking down the barrier between expertise and the public. Any successful endeavor at realizing a more sustainable planet involves work, collaboration, and action at this intersection.

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BOOK REVIEW PERSPECTIVES

David W. Orr, *Down to the Wire: Confronting Climate Collapse*

Oxford University Press, 2009, 288pp, ISBN: 0195393538

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Given the enormity of the subject matter, writing a relatively short and accessible book on the social aspects of climate change is a considerable challenge even for the most seasoned writer. This has not deterred David Orr, with his book *Down to the Wire* ranging over topics that include religion, politics (and the connections between the two), energy systems, and the psychology of hope and denial. These all are vital components of the unequivocal imperative of addressing climate change that, as Orr unrelentingly argues, necessitates nothing less than a complete reconstitution of how we think and live today. With the undoubted aim of convincing the reader likewise, he surveys an eclectic array of arguments and data from science, theology, activism, and philosophy, drawing them together through his obvious passion for this topic. Written for the nonspecialist, *Down to the Wire* has a breadth that will appeal to those willing to follow a knowledgeable writer along his journey to find palpable ways forward in garnering the will and means to combat climate change.

Down to the Wire outlines and continually returns to the many challenges climate change presents, discusses why so little appears to be changing despite the pending catastrophe, and outlines Orr's own ideas on what can be done. In doing so, the book has some definite strengths. For example, Chapter 4, "The Carbon Connection," tells human stories of loss and vested interests that sit behind the devastating mining across American states such as Kentucky and West Virginia, enabling the reader to connect with these particular people and places. Chapter 5, "The Spirit of Connection," makes the convincing case that without a sense of gratitude for our own lives and a belief that we, as a species, deserve to persist, all our attempts at sustainability will be in vain. And the final chapter, "The Up-shot: What Is to Be Done?" outlines the steps that the newly-elected (at the time that Orr was writing this book) President Obama must undertake to begin to address some of the many political, social, and psychological challenges presented by climate change.

Despite these strong points, *Down to the Wire* has its flaws. For one, writing this from Australia, I am struck by how this book is primarily written from an American perspective and for an American audience. Indeed, all its examples of political institutions and events, history, religious trends, and detailed case studies of environmental destruction are drawn from the United States. On the one hand, the international reader is able to make her or his own connections at many points, such as when Orr discusses the public's growing cynicism toward political institutions. On the other hand, he rarely makes any overt connections to countries outside the United States, ironically giving *Down to the Wire* a hint of the myopia that Orr criticizes in American politicians. As a result, the international reader faces many points of exclusion, such as some very particular political references and historical machinations probably lost on those not fascinated by all things American.

Indeed, the identity of the intended readers of *Down to the Wire* remains hanging as one progresses through the book. In an attempt to cover such a substantial territory, many key concepts and sweeping assertions beg more questions than they answer, possibly satisfying neither generalist nor specialist readers. For example, key concepts like "ecological debt" are dealt with too quickly and lightly, and the assertion that the United States may not have the adaptive capacity to manage climate change is made and then set aside. No doubt, it seems churlish to focus here on the perennial breadth-versus-depth challenge that all writers face. However, to my mind, this points to a more substantive concern with *Down to the Wire*.

In writing this book, Orr is obviously a man frustrated at social inaction on climate change. Yet, he appears still determined to, and wants to convince others, that we can turn things around: an admirable sentiment indeed. However, as a result this book feels like a somewhat erratic and highly personal search for answers, structured around the issues that interest the author. This approach invites an eclecticism that some will find exciting and interesting, but for others–such as me–makes it hard to remain engaged. Still, whatever one's reaction to Orr's style and

agenda, one has to admire the author's dogged determination to provoke readers into rethinking their approach not only to climate change, but also to how we view our place and role on this Earth.

About the Author

Kersty Hobson is lecturer in the Fenner School of Environment and Society at The Australian National University. She has a background in anthropology and geography and has undertaken research into household sustainable consumption and public responses to climate change in the UK and Australia, as well as on nongovernmental organizations and civil society politics in Singapore and East Asia.

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The overarching contribution of David Orr's book, *Down to the Wire: Confronting Climate Collapse*, is its holistic and integrated focus on the social, cultural, economic, and political dynamics that have exacerbated global warming and how the insight gained from taking a broad view can provide a path forward. He suggests that the enemy is us, but that solutions are within our grasp. We have one planet and *very* limited time to change the escalating trajectory toward what Orr describes as environmental and societal devastation. This volume is a great companion to James Hanson's latest and more technical book on the science of climate change, *Storms of Our Grandchildren*, that focuses on the drivers of human-induced climate change.

The first part of Orr's book addresses governance and politics, arguably the center of the conundrum that our global society is facing in effectively responding to climate change. He provides a checklist of anticipated adverse effects and conveys a sense of urgency to act decisively, a theme repeated throughout the book, to significantly reduce the volume of greenhouse gases entering the atmosphere. Orr highlights the high procrastination penalty that we confront to underscore the vital need for decisive mitigative action. The book describes probable types of climate change and their societal effects, such as the loss of ecosystem services relevant to the human population. The author suggests that developing countries are particularly vulnerable to dramatic climate changes such as extreme weather events resulting in floods or droughts that threaten subsistence farming. In addition, tropical diseases could move into formerly temperate zones. In the United States, some climate models predict that the Midwest, considered the nation's breadbasket, will become arid. Orr does not go into detail concerning the probability or specific nature of these adverse impacts. Rather, his book is a vehicle to raise awareness about the risks we all are likely to face if extensive mitigative measures are not initiated soon.

The book's most compelling text describes characteristics of society, particularly in the United States, that have led to our untenable situation. He advocates that the familiar notion of the tragedy of the commons includes being infatuated with consumerism, ill-informed, and intellectually bankrupt–a compelling hypothesis reinforced throughout the volume. He points out that the global economy is ever more connected and interactively complex while reflective of societies, resulting in greater collective vulnerability to climate-related stressors. The conundrum of climate change requires a new strategy for facilitating collaborative global governance.

The second part of the book deals with connections, first of adverse societal impacts related to global warming via Hurricane Katrina and then of fossil-fuel extraction via the practice of mountain-top removal mining in Appalachia. They are two sides of the same fossil fuel-social injustice coin. In both accounts the spirit, culture, and physical structure of local communities have been devastated. In conveying those two stories, I was taken by how the author vividly illustrated causal societal connections. The second type of connection is less obvious, but represents more of a disconnect, an obstacle to overcome. The philosophically divergent perspectives of environmental stewardship versus natural resource utilization is a challenge. Orr's discussion of this quandary compares divergent extremist perspectives of religious fundamentalists believing in creationism and rapture to environmentalists focused on sustaining natural ecosystem processes and functions. He offers the provocative question of whether the power of persuasion of one perspective will prevail or whether societal reciprocity, based on gratitude for the joys of life, will lead to a convergence of will. Is our concern for our children and future generations an overriding factor? I bet on those fundamental family values. As Orr suggests, "what is given must be passed on. Gratitude requires mindfulness, not just intelligence."

The third part of the book deals with the long view of farther horizons and hope. Orr suggests that "the self induced crisis of planetary destabilization is an invitation for transformational leaders to help us rethink our place in the world and the way we relate to each other and the web of life on the planet." And he rightfully contends that a sustainable society depends on psychological health and people's sense of connectedness. All that sounds warm and fuzzy, but

Down to the Wire does not provide much specific insight on how to establish global consensus and resolve to act collectively. Orr acknowledges that effective leadership is "the rarest of human traits" and he suggests looking inward at who we are as individuals and as a culture and what we know of ourselves.

What the volume does not offer are many specifics as to successful policies and sustainability practices, many already in place, to address the range of climate-related threats. The impact of Orr's message is significantly compromised by his not displaying leadership himself. That task seems to be left for another book, but there are numerous models of technology and conservation practices that could have greatly strengthened the case for the *feasibility* of the general concepts he proposes. For example, California Governor Arnold Schwarzenegger is the leader of the seventh largest economy in the world. He is directing formulation of one of the world's most progressive and comprehensive green energy programs. Initiatives include limiting greenhouse-gas emissions, increasing vehicular fuel-efficiency standards, retrofitting buildings for energy conservation, facilitating renewable energy sources such as solar and wind, and building a mass transit system.[1] Another example, representing primarily the private sector, comes from Michael Kanellos, editor of *Green Tech Media*, who posted an article on Earth Day 2010 titled "10 Green Giants that Could Change the World."[2] For instance, General Electric has a US$400 million contract to provide compression equipment and services to the world's largest carbon-capture project and Dow has launched a multi-pronged strategy to exploit its know-how in membranes, coatings, and material science to reduce the volume of fossil fuels consumed by its manufacturing operations.

An editorial in the April 19, 2010 issue of *The New York Times* concerned the Icelandic ash plume that shut down air travel over much of Europe for nearly a week. The last two lines are, "It will be a long time before we forget the threat that lies smoldering under an Icelandic glacier. Or its lesson that even in the 21st century, our lives are still at the sufferance of nature."[3] Hopefully, the vital message from David Orr's very important book that we must reduce this devastating threat of global warming to nature and humanity before we reach the point of no return will resonate over the long term as well.

[1] For further details refer to the website of the California Energy Commission at http://www.energy.ca.gov.

[2] See http://www.cbsnews.com/8301-504466_162-20003149-504466.html.

[3] See http://www.nytimes.com/2010/04/19/opinion/19mon3.html.

About the Author

John Peine is a social scientist with the U.S. Geological Survey stationed at the University of Tennessee in Knoxville. From 1982–1992, he served as Chief Scientist at Great Smoky Mountains National Park. He is the editor of and a contributor to the 1999 book *Ecosystem Management for Sustainability: Principles and Practices Illustrated by a Regional Biosphere Reserve Cooperative*. He has contributed to the books *A Land Imperiled: The Declining Health of the Southern Appalachian Bioregion* (2005) and *Conservation of Rare and Little Known Species: Biological, Social, and Economic Considerations* (2007). More recently, he is coauthor of the paper *National Biological Information Infrastructure Data Management Toolkit* (2009) posted on the U.S. Geological Survey Open-File website. He just completed a project devising a strategy for systematically incorporating social and economic dimensions into analysis and decision-making processes associated with habitat conservation and recovery plans for endangered species. A member of the IUCN World Commission on Protected Areas–Mountain Group, his current research focuses on leadership in ecosystem management and seeks to document best environmental sustainability practices.

Terence Jeyaretnam

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David Orr was part of the team that over a two-year period prepared recommendations for climate-change action during the first 100 days of the new American presidential administration that began in 2009. He describes *Down to the Wire* as a follow up to that project. The book digs deeply beyond the thin veneer of global discussions around climate change. Beyond a personal journey, it examines the communication challenges and policy-setting barriers presented by climate-change issues that are inherently presented within a vortex of uncertainty. Finally, it is a book about making real, local changes, with a message of hope and how hope could take root.

Down to the Wire indeed does take us down to the wire on climate change. I suspect that many of us in Western societies have the same feeling deep within of apocalypse regarding the way our population is growing; the way we each create a mountain of waste every day not knowing where it disappears to or why we needed it in the first place; the way we put another seventy liters of petrol in our over-sized cars knowing the harm it is creating yet feeling it is a necessary evil; the way our feet seem to bump into the litter on the streets while we hope that someone else will clean it up; and the way the insatiable appetite that we all seem to have growing within us, as we are driven to crave more and more material things to

clutter our lives. I think that our brains have processed the messages and background information and have come to the conclusion that something is not right–that it cannot be right, cannot be sustainable. Orr just lays the truth out that something is terribly wrong and that we are pretending that, like most things, there will be a quick fix. If I have any criticism, it is only that the book is primarily written for an American audience, when the problem, the challenge, and the necessary response are of a truly global nature.

Down to the Wire is a book that *hard wires* reality–that climate change and environmental degradation are issues beyond scientific, technological, and economic realms. They are issues of ethics and governance. The book explores the meaning of our existence through carbon (our makeup as well as that which makes up fossil fuels and contributes to greenhouse warming) and spiritual connections. It describes our presence as what the Spanish philosopher Miguel de Unamuno calls "the tragic sense of life," a sober philosophy, free from the delusion that humans should not assume that we can be "as rich as possible for doing as little as possible." Or as Orr eloquently puts it, "recognition of tragedy has the honest recognition of what we are, who we are, and what we can be, but aren't yet. I think this opens us to genuine nobility, not just affluence, not just power, not just domination of the world, but genuine nobility."

The book is also a personal journey. The author describes his experience during the summer of 1980, one of the hottest and most unbearable summers on record in much of the United States, as a preview, a very small opening, into a world confronting climate collapse. He wonders how our infrastructure, our bodies, and our minds will be able to cope under such extreme weather. Clearly a well-read man, receptive to the physical changes he has seen during his short time on Earth, Orr comes to his conclusions through the marshalling of scientific, as well as anecdotal, evidence, a personal touch that he is able to deliver in this soul-searching book.

This volume is also about communicating the conundrum of climate change. Orr does not like the idea that the public can handle only good news. For him, humans should be treated as intelligent creatures capable of "handling the truth." He explores some of Abraham Lincoln's and Winston Churchill's speeches in the face of insurmountable challenges and draws out how they managed to convey hard reality. The book conveys the importance of setting out the facts and the likely tragedies that will unfold, yet gives society something to hold onto and work with, acknowledging that we are perhaps beyond prevention and into a phase of building resilience. At times, though, the book is about a wilting planet. As Orr describes it, "So now, in Biblical terms, we're evicting ourselves from this Garden of Eden called the Holocene."

Finally, the book is about hope, "in a long emergency" which, in its most real sense, the author is engaging in himself. Hope, as Orr says in the volume, is "a verb with its sleeves rolled up." In contrast to despair or optimism, that both require one to do nothing, hope requires action. The transition movement of which Orr is a part–the Oberlin Project (which aims to turn a 13-acre piece of land that Oberlin College owns into a certified green neighborhood)–is the ultimate act of hopefulness. The *sustainablist* in him comes out with sleeves rolled up, with a smile on his face, with a sense of eternal optimism, with Gandhian principles of nonviolence, with a fatherly look of hand-holding to help us navigate our way through the most pressing challenge of our time.

About the Author

Terence Jeyaretnam is founder of Net Balance, a sustainability advisory firm with offices in Melbourne, Sydney, and London. He holds a degree in environmental engineering and is a Chartered Professional Engineer and a Fellow of the Institute of Engineers Australia. He is one of six professionals globally to be awarded the grade of Lead Sustainability Assurance Practitioner by the International Register of Certified Auditors (IRCA). Jeyaretnam was formerly the chair of the College of Environmental Engineers and Engineers Australia's Sustainability Committee. In 2005, he was named one of the ten most influential young engineers in Australia by Engineers Australia. Net Balance has recently been selected by Australia's *Business Review Weekly* as one of the 100 fastest growing companies in the country.

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How come our climate has gone crazy? Global warming, stupid! It is an American euphemistic answer to historic environmental disaster, the most serious issue of the new century. As David Orr clearly explains in the preface to his new book, "The ongoing disruption of the Earth's climate by man-made greenhouse gases is already well beyond dangerous and is careening toward completely unmanageable." Naturally, it is a matter of human sustainability, which is in everyone's interest. Yet, most Americans continue to deny the reality of the first global human-made environmental disaster that has already begun. It may not be surprising that Americans, democratic capitalists, are busy enriching themselves and enjoying individual peace and freedom. Americans, being

moral individualists, perhaps are too embarrassed to admit that we are the primary culprit. Amidst intellectual paradox and denial, we are at the crossroads to redirect our destiny for humanity's future.

Down to the Wire: Confronting Climate Collapse presents an excellent dissection of the issues pertaining to ominous climate change, with the focus on American governance and politics. Orr opens many doors for all of us to debate and research, although his discussion is primarily directed to strategies in the sociopolitical, economic, and cultural domains. His powerful analysis of intellectual paradoxes certainly ignites the core of our conscience, from the individual to the leadership level of American society. In this sense, considering the trends and attitudes of world leaders in dealing with international economic and environmental issues, his treatment of global climate change is rather narrow and somewhat inadequate for the even broader worldwide debate that we now need. On global issues, the world community respects and expects American leadership, which is still of paramount importance for policy and mitigative efforts. At the same time, Americans are not readily open to global environmental issues even though, as the most developed nation and a global leader in science and technology, we are in many ways responsible for climate change. As recent opinion polls show, Americans are the people least aware of industrial and technological abuse of the world environment and most skeptical of global warming. Similarly, the American media downplay global environmental issues like biodiversity, for instance neglecting the 2005 release of the historic Millennium Ecosystem Assessment, the most ambitious study ever of planetary ecosystem health. Climate change is nevertheless everybody's concern as a matter of human sustainability. Our audience is now global.

The issues of global climate change are complex, involving a wide range of economic and sociopolitical perspectives linked to almost every fabric of our society. Climate change is closely tied to fossil fuel, which is then connected to international policy and economic development. Thus, climate change represents the anthropogenic assault facing the entire Earth ecosystem. Compounding this problem is a huge demographic load of 6.8 billion people. Resource overuse and increasing energy demands are complicated by an impending shortage of oil, dilemmas made worse by the collapse of the American financial system. As Orr describes in abundantly clear terms, climate change offers the first global evidence of how and how much we have abused our planet's ecological integrity.

In the sustainability context, as we enter the period of mitigation and rebuilding nature for human sustainability, I am concerned that global agreements dealing with environmental issues such as biodiversity loss and climate change often move to the back burner without specific resolution as other hot issues arise. Concern about global biodiversity loss, along with the spirit and excitement of the Convention on Biological Diversity (CBD), started at Rio de Janeiro in 1992 and quickly spread worldwide, but gradually declined to the point of oblivion. This year world governments failed to deliver on commitments made in 2002 to reduce global biodiversity loss by 2010; instead, the planet has seen alarming biodiversity declines, as reported by the *Joint News Release* (29 April 2010) from the 2010 Biodiversity Indicators Partnership, UNP/CMC, BirdLife International and CBD. To most Americans, the CBD is a historical note and biodiversity is no longer something we must protect. The United Nations and its agencies maintain minor activities, although these are mostly administrative functions with practically no productive consequences. Even the Year of Biodiversity, designated for 2010, is hardly noted or celebrated in the United States and most other countries. Similarly, the Copenhagen climate summit of 2009 collapsed and cast a negative shadow over the global climate movement.

In the face of these catastrophes, the core of Orr's analysis offers diverse approaches to resolving the emerging disaster. The mitigation of global climate change, currently planned through carbon trading and carbon-emission control, could come to the same fate as the CBD because global environmental issues require collective sacrifice. The massive expenditure needed from every nation would involve the economic and social lives of all people. However, although many intellectual and public leaders do understand what biodiversity is and what the CBD stands for, we cannot expect people to sacrifice their tight personal resources to support global environmental issues.

Even the knowledge base behind our understanding of biodiversity has not been enriched recently, notably within the context of taxonomy, the most basic science that has built our understanding of global biodiversity since the Linnean period over 250 years ago. Taxonomists in universities and natural history museums provided knowledge in the form of species identification and biodiversity classification, collectively called taxonomic service, of plants, animals, fungi, and microorganisms. This loose scientific infrastructure has rapidly declined since the 1992 Rio Declaration and has now almost collapsed without any new models. This decline is greatly hampering the discovery and description of new species worldwide and retarding the advancement of knowledge about global biodiversity that is baseline data for human development and sustainability. This trend

became even more vivid and disturbing to me last year when I read *Biodiversity and Landscape: A Paradox of Humanity* for its new release in paperback (2009).[4] All of the predictions regarding biodiversity presented by my colleagues of distinguished scholarship and scientific accomplishment were as ominous and disturbing as in the original edition (1994). I am afraid that an intellectual paradox is deeply ingrained in human nature, expressed by the anthropocentrism that is at the core of our approach to advancing science and technology, as well as in recognizing and admitting the human abuse of our life-support system.

In Chapter 6, "Millennial Hope," Orr discusses the possibility of averting climate-change catastrophe with technology that raises serious ethical questions because it means unprecedented technological experiments on our planet. If they fail, these experiments could add to global disaster and cloud the future of human sustainability. A recent issue of *The Economist* (April 24, 2010) had several articles on the impacts of the Icelandic volcanic eruption. Like this spectacular volcanic show that we could only watch on our television screens or through the window of a flying helicopter, we are basically helpless regarding natural events, particularly those seriously affecting biodiversity, the environment, and climate at the global scale. Beyond watching with indignation, all we can do is work on mitigation, security, post-event repair, and perhaps rebuilding. Yet, there is always someone with the power of technology who tries to control natural phenomena as well as human-made climate change. To counterbalance the impacts of global warming, the idea of "geoengineering" to cool the atmosphere is floating around among technologists. This is not surprising in the sense of the anthropocentric mentality–simply stated "we can control it with technology since we made it amiss." Regrettably, we have not learned that we cannot control natural phenomena such as volcanic eruptions, earthquakes, tsunamis, or even a regional hurricane like Katrina. With climate change, however, anthropocentric problem solving for the benefit of humanity has become a threat to human sustainability.

Humans are a curious and inventive hominoid species, *Homo sapiens* Linnaeus, with large brains and apt genetic makeup to successfully survive, expand our habitats, and modify the environment. These traits finally led humans to take over the Earth system. Ever since hunter-gatherer days, through the development of agriculture about 10,000 years ago, we have expanded our needs and found ways to meet them. Since the development of organized societies built on productive agriculture, wars and warfare broke out for territorial or religious causes and never ceased for long. With these wars, fighting tools, arms, and armament technology evolved. Throughout human history, we have never learned to avoid warfare and sustain peace. After the Industrial Revolution, science and technology advanced and our intellectual capacity for innovations and invention grew. Technological progress accelerated, along with the development of public education that facilitated technology's phenomenal advance, particularly during the last century. In the modern technological world, we are faced with unprecedented challenges such as climate change and biodiversity loss, among other environmental disasters. The impacts of rapidly growing technological innovations are not nature's products, but human-made effects for the sake of problem solving, entertainment, or advancing needs.

Technological advance through anthropogenic-driven innovation continues and may be able to improve our livelihoods and enhance our capacity to survive in the new millennium. Anthropocentric technology usually meets the intended objective, but with a bag full of side effects that later come to haunt us. To win World War II over the Japanese empire we invented and exploded atomic bombs, but ever since nuclear bombs have evolved and became a perpetual threat to humanity. Even today, Iran and North Korea's nuclear ambitions are political quagmires for the world community. Now, we have reached the point of no return for a planet loaded with 6.8 billion people who demand crucial ecosystem services and products that are increasingly difficult to sustain. Every aspect of our technological success resulted in a paradox of economic gain and ecological loss with no clear direction for getting back on track. We needed better transportation, which produced automobiles; we needed more energy, which produced coal mining and nuclear power; we needed more food for a rapidly increasing population, which led to more chemical fertilizer and pesticides; and so on. We have now reached the point of no return for the Earth system burdened with people pursuing the lifestyle Americans have developed for the last century. To resolve the anthropocentric paradox we need a new paradigm to look at the Earth system in a natural context, not anthropocentrically as a collection of objects.

The Industrial Revolution jumpstarted human population, adding more than six billion people to the planet during the period of 1800-2010, with an addition of 4.3 billion since 1950. Endless economic expansion eventually yielded global economic failure and financial devastation on "mighty" Wall Street in 2008. In other words, anthropocentric approaches to

[4] Kim, K. & R. Weaver (Eds.). 2009. *Biodiversity and Landscape: A Paradox of Humanity.* 2nd ed. New York: Cambridge University Press.

development and decision making brought humanity to where we are today: a global environment with a polluted landscape, a warming biosphere that is in the process of being transformed into a "chemosphere," a changing climate, and a collapsed economy and financial system. Contemporary reality blinds intellectual elites who continue searching and experimenting without definable principles or viable models to renew our broken system. Leaders and people all around the world are trying to stop the decline of humanity and to stabilize the environment with anthropocentric approaches and technology and a compulsion for continued economic growth. We can no longer afford to look at the Earth system without recognizing the dynamics of our life-support system as the basis for the future of humanity.

The issues dealt with in this book are at the heart of environmental disasters that may determine the future of our life-support system as well as our evolutionary destiny. Life on Earth has existed for 3.5 billion years. The global biodiversity that sustains it did not emerge suddenly during the last century, but rather evolved over many millions of years in each unique lineage. Throughout geological history, natural events such as earthquakes and volcanic eruptions, as well as their related after-effects like tsunamis and natural climate changes, have not been in the human domain. These natural events changed geology and the global environment, overhauling the planetary system, renewing biodiversity, and refreshing the global living system. While these events occurred before the emergence of humans, we now face not only natural disasters, but also disasters of our own creation. To mitigate the impacts of climate change on biodiversity and ecosystems and to protect humanity from destruction, we must better understand what nature is all about and what biodiversity–all these organisms, big and small, pestiferous and beneficial, plants, animals, fungi, and microorganisms–truly means to us.

We must better understand how nature sustains ecosystem function and services and how our fellow species evolve irrespective of how we have abused them under the drive of an anthropocentric worldview. As the primary resource and capital for sustaining our life-support system, global biodiversity must be protected. Our knowledge base, including crucial information about the dynamics of the biosphere, biodiversity, ecosystems, and climate change, needs to be expanded at both local and global scales. We must dedicate ourselves to the perpetuity of the Earth's species. Otherwise, we have to prepare for the extinction of the human species. As Orr states, we must continue the work of public institutions like NASA, the (now defunct) Office of Technology Assessment, and the Office of Science and Technology Policy that provide crucial information and strategies for humanity beyond anthropocentrism.

About the Author

Ke Chung Kim is Professor Emeritus in the Department of Entomology and Director Emeritus of the Center for BioDiversity Research at The Pennsylvania State University. Kim is a biodiversity scientist whose work has built on insect taxonomy/systematics, ecology, conservation biology, evolution, and natural resource management. He founded the Center for BioDiversity Research in 1989 and has helped assess biodiversity in Pennsylvania and South Korea ever since. In 1997, Kim founded the DMZ Forum, a nongovernmental organization that promotes the preservation of Korea's demilitarized zone for conservation and peace. In light of the recognition of biodiversity loss and its impacts on ecosystems throughout the world, Kim shifted his interest ten years ago to issues of human sustainability and has written on many aspects of biodiversity and its continued loss. He has promoted the concept of biodiversity related to human sustainability through biodiversity assessment and monitoring, research, and public lectures worldwide. Kim convened a major conference in 1990 titled "Biodiversity and Landscape: A Paradox of Humanity" that gave rise to a book with the same title.

Rejoinder from the author

David W. Orr

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First, I would like to thank the four reviewers for their perceptive comments and the editor for the opportunity to make a brief response. Every author needs to say what a book is and what it is not. *Down to the Wire* was indeed written as several reviewers noted, for an American audience for reasons that I explain in the Preface. The United States has been the heart of the problem and can still be a major factor in deflecting the worst of climatic destabilization. Second, again as I explain in the Preface and Introduction, the book is a companion piece to my involvement in the President's Climate Action Plan (PCAP, 2008), which targeted the first 100 days of the Obama administration, as well as the "Oberlin Project." The latter is a partnership I helped to launch, direct, and fund between Oberlin College and the City of Oberlin to create an integrated model of post-fossil fuel sustainability. Against this backdrop, the book is a meditation on the largest challenge humans have ever faced. Third, the book is not specifically about policy, which has been covered exhaustively, as I noted, in the PCAP. It is about leadership, especially the kind that helps connect us to deeper levels of obligation and opportunity.

I began the book with a quote from David Archer's *The Long Thaw* that describes the temporal dimensions of climate change. Even were we to stop emitting carbon dioxide today, Earth's temperature would continue to rise, as would sea levels, for another thousand years or longer. That is about the best that we can expect. Twenty percent of the carbon released today will remain in the atmosphere for the next 100,000 years. We have created a different planet, one Bill McKibben (2010) describes as *Eaarth*. The sheer longevity and magnitude of what we have done and are doing defies comprehension. We have effectively evicted our descendents from the only paradise humans have ever known—what geologists call the Holocene. Problems, we like to assume, are solvable, but this one is not. Hopefully, we still have time to contain the worst of what lies ahead, but only if we move quickly and smartly.

That said, there is real disagreement about how and what to communicate to the public. On one side are those who prefer to present a "positive," upbeat message or what Gus Speth calls "happy talk." On the other side are those who believe that the public can handle the truth and that that capacity is the best chance we have to mobilize enough people to do enough to avoid the worst. Lincoln, Roosevelt, and Churchill, for example, did not sugarcoat the great challenges of their time as "economic opportunity." To the contrary, they described them as moral dilemmas and national catastrophes that would require sacrifice and blood. But the disagreement is an honest one. For my part, I would prefer to tell the truth as best I can, and get down to work helping to build something better where I live.

About the Author

David W. Orr is the Paul Sears Distinguished Professor of Environmental Studies and Politics and Senior Adviser to the president of Oberlin College. He is the author of seven books and a Trustee of Bioneers and the Alliance for Sustainable Colorado.

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