WHEN ARE TECHNOLOGIES SUSTAINABLE?[1]

Stanley R. Carpenter, Georgia Institute of Technology

During the latter half of the twentieth century philosophers of science have devoted considerable attention to the incommensurability of competing scientific theories. This paper applies elements of these discussions to the question, "When Are Technologies Sustainable?" It identifies an incommensurability issue accompanying the topic of sustainable technological practices and locates it within contrasting stable-state and growth-oriented economic models. While it is not argued that intra-theoretic incommensurability completely prevents meaningful discussions between these rival models, it is contended that disagreements about the meaning of "sustainability" are not purely technical in nature. The point is defended that coming to understand the issue in the "sustainability" debate involves "framing the issue" or "grasping the point" of each competing approach. "Sustainability," as an idea that functions incommensurably in rival economic theories, can best be analyzed as a Wittgensteinian "form of life." This characterization will lead to the identification of normative factors that typically are missing from attempts to characterize technological practices as sustainable or unsustainable.

A recent book by Herman E. Daly and John B. Cobb, Jr., *For The Common Good*,[2] is subtitled *Redirecting the Economy Toward Community, the Environment, and a Sustainable Future*. The influential report of the World Commission on Environment and Development, which appeared in 1987 under the title, *Our Common Future*,[3] and which is commonly called "The Brundtland Report," after the commission chair, Norwegian Prime Minister Gro Harlem Brundtland, focuses on the topic of sustainable development. William Ruckelshaus, United States representative to this commission, suggests, in an article in *Scientific American,* that world citizens need to acquire a "sustainability consciousness."[4] The concept of sustainability has thus begun to assume a central place in science and technology policy discussions, particularly as world wide environmental problems increasingly become matters of general public concern. Yet, there is little consensus about the meaning of "sustainability." Disagreements involve a host of assumptions concerning, not only what exactly is to be sustained (for example, is sustainable economic development different from

sustainable growth?) as well as what are appropriate levels of such sustainability, but also more fundamental disputes over legitimate methodologies for setting sustainability levels in general, along with basic methodological issues over what would count as acceptable standards of proof that sustainability has been achieved. Epistemologically, I wish to argue, we may usefully frame the dispute concerning what genre of argument carries weight at all as a type of conceptual incommensurability called "framing incommensurability." It occurs when two conceptual systems fail to frame situations in exactly the same way such that there is no one to one correspondence between the concepts of the two systems.[5] The phenomenon of framing incommensurability is exemplified when disagreements center as much on what kinds of questions may be legitimately asked as on the correct answers to questions that are considered crucial by the disputants. Failure to agree on a common agenda of questions, or even a common context in which the questions are framed, can lead to the phenomenon Thomas Kuhn has identified as disputants "talking through each other."[6] I believe that Joseph Margolis nicely captures this phenomenon in the following description. He observes

> that under the … conditions of historical existence or under the conditions of adhering to different theories, different research projects, different paradigms, different modes of training, orientation . . . different investigators are, on the available evidence, often unable to incorporate an adequate and coherent picture of one another's conceptions *within the terms of reference of their own* (emphasis added).[7]

The two disparate systems here identified as exemplifying framing incommensurability are growth and steady-state economic models. Three dimensions of the problem are identified: (1) choice of root metaphors to describe economic processes; (2) sociological characterizations of economics; and (3) designations of limits within each approach. In the case of steady-state economics, I hope to show that an economics of sustainability engages questions, particularly those addressing equity issues, which have traditionally been isolated to separate spheres of market economics and political liberalism. A listing of such problematic questions may help to characterize sustainability discussions. Is the formulation of a sustainable economic policy a technical issue? Should policy makers concentrate on fine tuning existing economic models to reflect more accurately the costs of resource depletion, say, by refining our measures of

marginal social product; or should they redirect their attention to policies that promote lifestyles embodying restraint of demand?[8] Are problems of resource depletion always correctable by means of better resource management or must policies be devised that encourage a new mind-set or "sustainability consciousness," as Ruckelshaus calls it? Brundtland calls for "a new era of sustainable economic growth in which growth itself 'enhances' the resource base rather than degrading it,"[9] but are "growth" and "sustainability" contradictory norms thus relegating the phrase *sustainable growth* to the status of an oxymoron? Is the issue of enhancement that Brundtland speaks of a technical question or are there broader moral issues at stake? Furthermore, does this emphasis on enhancement of the resource base perpetuate the mentality that nature is nothing but a resource? By embracing "soft technological paths" of resource use, can we continue to appeal to a growth model of market economics or is some form of steady state approach essential?[10] Are growth models and steady-state models mutually exclusive approaches, or may we formulate sociopolitical theories that avoid these categories altogether? For example, is it desirable merely to substitute one particular economic model for another, say, one emphasizing the linearity of entropy increase over the circularity of supply and demand, or must we attempt to replace the traditional scope of economics itself, viewed as a separate social institution, with novel political structures that avoid the radical separation of the market and the polity?[11]

Fundamental epistemological issues are involved when we attempt to categorize answers to these questions. What categories of answers count and which are to be ruled out? Is the question of maximum sustainable yield a matter for science or for ethics? Jorgen Randers and Donella Meadows, for example, in arguing for limitations to growth, suggest that as economic technicians we should greatly increase time horizons over those of current practice when comparing costs and benefits of production processes. They then add, however, that it is up to the moral and ethical leaders of the world societies to "adopt the goal of increasing the time horizon of" human activity.[12] Their recommendations contain a curious mixture of conventional economic theory and ethical exhortation. What would count as confirmation or refutation of their position? What is their basis for deciding what is or is not a question for economists to address; what are their principles for separating economic apples from ethical oranges?

The phenomenon of framing incommensurability provides a vehicle for

characterizing the disparities between growth-oriented and steady-state economics. By locating each theory within its context of distinguishable social practices, and by identifying incommensurable frames of reference, we may see how ideas of sustainability can range from peripheral technical matters to constitutive axioms of the theory. Each approach exists against a background of core terms, methodologies, central problems. Each is legitimated, I would contend, by incommensurable lines of demarcation between economic and ethical systems.

First, while growth and steady-state models each employ both linear and circular metaphors in explaining the economic process, their applications are strikingly different. Growth proponents describe production/consumption and supply/demand in circular flow terms while minimizing the linearities of resource depletion by means of beliefs in the fecundity of the market to produce substitutes when depleted resources become too dear. On the other hand, linearity is reflected in growth model assumptions that increasing levels of well-being are directly correlated with linearly increasing consumption levels. Conversely, steady-state theories are likely to emphasize the linear second law of thermodynamics, the unidirectional increase in entropy as reflected in the historical vector of human productivity and consumption, and to define sustainability in terms of limits to the technological resource base: ultimately a reflection of the level of photosynthesis which is itself limited by levels of solar insolation. Additionally they focus on the cyclical nature of regenerative processes such as global hydrologic systems. Here, again, they note that the sun is the single energy source driving the hydrologic cycle.

Over twenty years ago Kenneth Boulding suggested still other root metaphors for the economic process when he questioned whether human welfare, ostensibly the *telos* of economics, was better understood as a stock or flow.[13] Is well-being a state or a process, he wondered? Against a backdrop of contrasting metaphors of "cowboy" and "spaceship" economies, he pointed out that consumption would be a favorable feature if well-being were a flow (the more flow, the more well-being), and something to be minimized if it were a stock (the less change in the stock, the more well-being). He called the matter of deciding whether the stock metaphor was better than the flow model an unsolved problem. It still is, and an apt example of incommensurability, for involved in the framing of the question there is a fundamental puzzlement about what would count as a convincing answer as well as what would be a reasonable approach to achieving

it.

One is struck in reading Herman Daly, E.F. Schumacher, Boulding, and other non-traditional economists by their preoccupation with "non-economic" issues. Ethics, religion, ecology are not only mentioned but linked substantively to their economic theories.[14] More traditional growth-oriented market economists, on the other hand, are liable to focus on matters of efficiency and to give short shrift to what they believe to be extraneous issues such as concerns about equity. A poignant exception here is Arthur Okun, who in his 1974 Godkin Lectures agonized over the tradeoffs between efficiency and equity that characterize the policies of market economics. Here Okun perceptively situates economic discussions of efficiency within the broader civic context, and shows how a social and political nexus of democratic rights is required both to meliorate the inequalities generated by an unfettered market, and to provide the civilized "level playing field" on which the games of the market take place.

Economics may also be characterized in sociological categories. Karl Polanyi, Okun's teacher, earlier argued the case that the nature and scope of market economics must be understood as an emergent social institution, an historical event, although not an inevitable expression of inexorable dialectical law. "Neither under tribal nor feudal, nor mercantile conditions," Polanyi writes, "was there . . . a separate economic system in society. Nineteenth century society, in which economic activity was isolated and imputed to a distinctive economic motive, was, indeed, a singular departure."[15]

Polanyi and others[16] argue a now familiar position that the successful functioning of the market requires a corresponding civilizing context, provided, in the case of Western market economics, by political liberalism. With an institutionalized division of labor between a business culture and a civic culture, the baseline conditions of a civilized polity are realized. Both poles of this bifurcated model of society view human nature in radically individualistic terms. On the one hand, we are described as atomistic consumers, expressors of preference satisfactions. On the other, we are individualistic bearers of rights, rights which in their least articulated form are negative in character, and which set boundaries that other individuals or institutions of the society may not cross.

The institutionalization of market economics and liberal democratic theory

generates its own logic, values, and goals. It defines the basic ontological unit, the individual, and what is central to our discussion here, both prescribes the subject matter of discourse and characterizes rational action. In the process, ethical and so-called spiritual issues are relegated to the status of non-economic concerns. The big tradeoff that Okun worries about between an efficient market and a just polity can be seen as an anomaly, an unsolved problem, of the market/liberal society paradigm.

Kuhn reminds us that reactions to paradigmatic anomalies are sociological in character, reflections of the enculturation, age, and shared values of the involved parties. Anomalies are embarrassments, responses to which may range all the way from a doubling of effort to patch up the received view, to its abandonment, and a shift of one's loyalties to a rival paradigm, if, perchance, a viable candidate exists. Any defense of the prevailing theory occurs within a structure of values, standards of proof, definitions of research agendas, identifications of relevant data, etc. Adoption of these factors reflect evaluative commitments. Decisions to relinquish the paradigm contain comparable non-rational elements. Furthermore, the abandonment of one's position is highly unsettling. While the new theory may address the anomaly, it will often frame other issues in ways that are foreign to the old agenda. We are at a loss to find a neutral perspective from which to evaluate the rival theories. Post-positivistic philosophers such as W.V. Quine argue in such cases against the likelihood of finding a single common denominator, an Archimedean point, or some culturally independent foundation of objective epistemological methodology, by which independently to adjudicate conflicts over theoretical anomalies.

Okun's big tradeoff is Daly's instance of irrationality. Not only does the market paradigm glorify utilitarian[17] and self-interested individualism while embracing unlimited growth in resource consumption, it relegates distributional and non-monetized values to a separate political sphere. Three categories of values and interests, for example, are particularly excluded: (1) those too diffused over time or space to play a major role in market transactions; (2) those associated with future generations; and (3) those not associated with persons at all, but with non-human nature.[18]

From the perspective of growth economics, economists who pay undue attention to these distributional problems are guilty of committing category

mistakes; of mixing the descriptive laws of the unfettered market with the normative distributional worries of the political culture. There is a three-way struggle occurring here among the institutions of the market, the liberal democratic tradition, and the new economics of sustainability. For the defender of the status quo it is irrational to try to fit the business and civic institutions to a single Procrustean bed. For the supporters of a new social institution, a sustainable steady-state economic system, the old bifurcation reflects outmoded institutions that are oblivious to new global realities.

Mark Sagoff convincingly argues that economics can be characterized either as the following of a method, or as participation in a practice according to virtues.[19] This distinction nicely captures the phenomenon of incommensurability and highlights its conceptual focal point: if the institution of economics is seen as the domain of micro and macro theories, reflected in sophisticated, quantitative models and criteria, and is situated against a background of positivistic epistemology, then a straightforward fact/value dichotomy follows. The case appears persuasive for excluding ethical questions such as those seeking to define the "summum bonum." If, on the other hand, we consider the understanding and implementation of economics as a value-laden practice according to virtues, then contributions of literature and religion, as well as science—indeed, every form of cooperative human inquiry—become both germane and necessary. "To be rational, on this view," Sagoff observes, "is to be honest, attentive, non-coercive and to avoid dogmatism, defensiveness, righteous indignation. It is NOT to claim that one's results are to be accepted because they 'correspond to reality'."[20]

Sagoff opts for this latter model of economics, and would, I believe, support the collapsing of the business/civic bifurcation of social reality into what I have called "the new economics of sustainability." It is this model of economics that steady-state theorists such as Daly promote, a model in which sustainability is always more than a matter for technical definition.

Questions of limits illustrate a third form of incompatibility between the traditional institution of economics, with its transference of moral questions to the political realm, and the new economics of sustainability, in which moral questions are embedded. For traditional growth models, scarcities of resources reflect natural material limits. Rational responses to these limits occur each time raw materials are transformed in an efficient manner. According to Daly, however, on

the traditional model there is no effective limit to the scale at which these transformations occur. Along with an awareness of inevitable spillover costs that are not reflected in the market models, steady-state economists emphasize the scarcity of throughput itself.[21] Considered a free good on the traditional model, throughput becomes scarce when the unidirectionality of the production process is taken seriously. Such explains Nicholas Georgescu-Roegen's inclusion of the Second Law of Thermodynamics within his economic model. Throughput itself can be recognized as scarce when it is acknowledged that the earth's regenerative processes are themselves subject to a law of diminishing returns. "When growth exceeds the optimal scale," Daly observes, "we experience generalized pervasive externalities, such as the greenhouse effect and acid rain, which are not correctable by internalization of localized external costs into a specific price."[22]

Limiting material and energy throughput to levels that do not degrade natural regenerative capacities seems to be the embodiment of prudence, growth models notwithstanding. Going farther, however, by beginning to speak of "sufficiency" of consumption is much more controversial. Schumacher appears to have abandoned his Keynesian roots for a form of religious mysticism in calling for optimal, rather than maximal consumption patterns, and then defining "optimal" as minimal material consumption along with maximum spiritual release.[23] While noting that "sufficiency" plays no role in modern economic theory, Daly, too, observes, "To define sufficiency one must ask 'sufficient*for what*?' The answer is 'sufficient for the good life.'"[24]

Summary: To summarize, I have attempted to locate discussions of sustainability within disparate economic paradigms. Additionally, I have suggested that incommensurabilities generated when alternative economic theories are framed make straightforward comparisons of these paradigms impossible. Three topics have been identified as illustrative of the general phenomenon of framing incommensurability. These are (1) choice of root metaphors portraying the economic process itself; (2) sociological descriptions of economics as an institution; and (3) alternative designations of limits constraining the economic process. Additionally, I have claimed that an economics of sustainability finds it necessary to frame questions that have received independent treatment by market economics and political liberalism, questions, that is, of sufficiency and equity.

The purpose of the discussion has been to recast the sustainability

discussions, to make disagreements between growth and steady-state economists appear deeper and more involved than they might otherwise seem; to suggest that the controversy is not fundamentally about efficient resource use but about human flourishing itself.

If what is called for is a redefinition of the good life that moves beyond economics and politics as we have circumscribed them in the West for the last three centuries, then loose talk about "the end of history"[25] will be seen as singularly inappropriate. Rather than think that the collapse of the eastern European command economies permanently settles questions of political legitimacy, we will need to attend to our own advancement from unsustainable technological practices that have too long characterized human action to alternate ones. I believe that, along with Ruckelshaus, it is advisable to hope that a "sustainability consciousness" will direct the next phase of history according to redefined ideas of political and economic feasibility.[26] What I have attempted to illustrate with this discussion of incommensurability is an epistemological point, that the acquisition of such a mind set will involve sets of conceptual roadblocks that significantly complicate attempts to formulate sustainable technological policies and actions.[27]

NOTES

1. Paper presented at the seventh biennial conference of the Society for Philosophy and Technology, Peniscola, Spain, May 21-23, 1993.

2. Herman E. Daly and John B. Cobb, Jr., *For the Common Good: Redirecting the Economy toward Community, the Environment, and a Sustainable Future* (Boston: Beacon Press, 1989).

3. World Commission on Environment and Development, *Our Common Future* (Oxford: Oxford University Press, 1987).

4. W. Ruckelshaus, "Toward a Sustainable World," *Scientific American* (September, 1989), pp. 166-175.

5. George Lakoff, *Women, Fire, and Dangerous Things* (Chicago: University of Chicago Press, 1986), p. 322.

6. T. S. Kuhn, *The Structure of Scientific Revolutions*, revised edition (Englewood Cliffs, N.J.: Prentice-Hall, 1970), p. 109.

7. Joseph Margolis, *Science without Unity: Reconciling the Human and Natural Sciences* (Oxford: Blackwell, 1987), p.19. I am especially persuaded by

Margolis's attempt to accommodate incommensurablism within a philosophy of science that is at once realist and relativist as he here does.

8. Neo-classical economist A. C. Pigou distinguishes as follows between "marginal social product" and "marginal private net profit." By the latter he means "that part of the total net product of physical things or objective services due to the marginal increment of resources in any given use or place which accrues in the first issuance—i.e., prior to sale—to the person responsible for investing resources there." On the other hand, "marginal social product" includes the "total net product of physical things or objective services due to marginal increment of resources in any given use or place, no matter to whom any part of this product may accrue." A. C.Pigou, *The Economics of Welfare*, fourth edition (London: Macmillan, 1932), pp.134,135.; cf. also Wolfgang Sachs, "The Gospel of Global Efficiency," *Orion*, (Winter, 1990), pp. 49, 50.

9. Gro Brundtland, "Change We Must," *New York Times*, 29 August 1990, p.23; reprinted from *Scientific American* (September 1989). The report of the World Commission on Environment and Development, which Prime Minister Brundtland chaired (and of which W. Ruckelshaus was a member) was entitled, *Our Common Future* (Oxford: Oxford University Press, 1987).

10. Amory Lovins, *Soft Energy Paths: Toward a Durable Peace*. (Cambridge, MA: Ballinger, 1977) is a good example of a proponent of alternative technologies that are environmentally gentle. In his most recent book, *Making Peace with the Planet* (New York: Pantheon, 1990), Barry Commoner criticizes Lovins's "neo-capitalist" approach as going too easy on the corporate technostructure. Instead, he says environmentally "soft" technologies must be complemented with politically "hard" strategies aimed at forcing prevention of pollution at its source and mandating materials recycling. Examples of "soft" political strategies include the present emphasis on pollution—regulation, which, he says, does not work—and "emissions trading" strategies, which create a market in pollution and, he contends, are immoral.

11. Attempts to formulate coherent alternatives to growth economics continue. Consider, for example, Herman E. Daly, and John B. Cobb, Jr.,*For the Common Good: Redirecting the Economy Toward Community, the Environment, and a Sustainable Future* (Boston: Beacon Press, 1989) in addition to Daly's earlier *Toward a Steady-State Economy* (San Francisco: Freeman, 1973). Daly acknowledges the influence of N. Georgescu-Roegen,*The Entropy Law and the Economic Process* (Cambridge, MA: Harvard University Press, 1971). Among other challenges to the growth axiom cf. E. Mishan,*Technology*

and Growth (New York: Praeger, 1969) and "On Making the Future Safe for Mankind," *The Public Interest* (Summer, 1977) pp. 33-61; E. Goldsmith, "A Blueprint for Survival," *The Ecologist* 2. In addition to N. Georgescu-Roegen and Herman Daly, Karl Polanyi criticizes the radical separation of market economics from the civil polity in *The Great Transformation* (New York: Rinehart, 1944).

12. Jorgen Randers and Donella Meadows, "The Carrying Capacity of Our Global Environment," in Daly (1973), p. 301.

13. Kenneth Boulding, "The Economics of the Coming Spaceship Earth," *Environmental Quality in a Growing Economy* (Resources for the Future, Washington, DC: Johns Hopkins University Press, 1966) reprinted in Daly (1973), pp.121-132. Despite his highly creative insights, Boulding must be regarded as the least radical of this group in terms of his disagreements with neo-classical market economics.

14. Herman Daly, "The Ecological and Moral Necessity for Limiting Economic Growth," paper delivered at the Conference on Faith, Science, and the Future, Cambridge, MA (July 12-24) (Geneva, Switzerland: World Council of Churches, 1979). Schumacher incorporates a mixture of Catholicism and Buddhism in his writings. Cf. his most famous article,"Buddhist Economics, " in his *Small is Beautiful: Economics as if People Mattered* (New York: Harper Torchbooks, 1973), pp. 50-59..

15. Polanyi, p.71.

16. Cf., esp. C.B. MacPherson, *The Rise and Fall of Economic Justice and Other Papers* (Oxford: Oxford University Press, 1985) and *The Political Theory of Possessive Individualism* (Oxford: Clarendon Press, 1964).

17. The implicit criticism of utilitarianism here is its assumption that what counts as a "good" is something which leads to an aggregate maximization of preference satisfaction without regard for how these satisfactions are distributed among the affected parties.

18. Lawrence Tribe, "Policy Science: Analysis or Ideology?"*Philosophy & Public Affairs*, 2:1 (Fall, 1972), offers supporting argument.

19. Mark Sagoff, *The Economy of the Earth* (Cambridge: Cambridge University Press, 1988), p.12.

20. *Ibid*.

21. Daly (1979), pp. 5-6 cites Boulding, who is not a proponent of steady-state economics and Georgescu-Roegen, who is.

22. Daly, *ibid*, p.9.

23. E. F. Schumacher, "Buddhist Economics" in his*Small is Beautiful:*

Economics as if People Mattered (New York: Harper & Row,1973), pp. 50-58.

24. Daly (1979), p.7.

25. Francis Fukuyama, "The End of History?," *The National Interest*, 16 (Summer, 1989), pp. 3-18.

26. Ruckelshaus, p.174.

27. The author wishes to thank Bryan Norton for his helpful comments in an earlier draft of this paper.