Energy Efficiency and the Theory of the Firm

Brent M. Haddad, University of California, Santa Cruz, CA Richard B. Howarth, Dartmouth College, Hanover, NH Bruce Paton, University of California, Santa Cruz, CA

ABSTRACT

The empirical observation that firms sometimes forego profitable opportunities to save energy appears to violate basic microeconomic principles, calling into question the traditional theory of the firm as a sufficient basis for analysis of energy policy. Several new perspectives on the firm – drawn from the fields of institutional economics, transaction cost economics, evolutionary economics, and resource-based strategy – offer insights that can both help explain the existence of the so-called "energy-efficiency gap," as well as suggest new approaches to the design of corrective or complementary measures. This paper explores the conceptual foundation of this anomaly and its links to the success of government-sponsored voluntary-compliance initiatives, such as USEPA's Green Lights and Energy Star programs.

Economics and the Energy-Efficiency Gap

The failure of markets to promote the full adoption of cost-effective energy-efficient technologies is empirically well-documented. The U.S. National Academy of Sciences (1991), for example, found that energy-efficiency improvements of 37% could be achieved in the United States through the implementation of technologies that yield net economic benefits under current prices and economic conditions. The technologies in question provide energy services such as lighting, space conditioning, appliances, transportation, and industrial processes in institutional settings ranging from private households to multinational firms. In a similar vein, the Intergovernmental Panel on Climate Change (1996) concluded that the increased use of demonstrated cost-effective technologies could reduce energy-related carbon dioxide emissions by 10-30% for the aggregate world economy. The achievement of this potential could contribute substantially to the greenhouse gas mitigation targets established under the Kyoto Protocol.

Attempts to explain the efficiency gap – the disparity between the level of energy efficiency achieved through markets and the level judged cost-effective through careful technology assessment – have focused mainly on market failures associated with household decision-making (Sanstad and Howarth, 1994). Consumers, it is claimed, hold imperfect information regarding energy prices, technology characteristics, and the amenity benefits associated with energy-efficient technologies. Alternatively, consumers are said to employ discount rates in the evaluation of lighting systems, appliances, and building shells that are substantially above the returns available on standard financial assets. Since the use of high discount rates is inconsistent with conventional models of rational intertemporal choice, these explanations appeal to "bounded rationality" (or departures from the "perfect optimizer" models of economic theory) as a possible basis for policy intervention (Howarth and Sanstad, 1995).

The market failures that impede the adoption of cost-effective improvements in energy efficiency, however, are by no means limited to households (Interlaboratory Working Group, 1997).

The demand-side management programs of the 1980s, for example, achieved considerable success in reducing energy use in commercial buildings — a context that is dominated by business, not personal, decision-making. In this setting, information asymmetries barred building owners and occupants from achieving mutual economic gains through the installation of advanced energy-efficient technologies. This problem of "split incentives," which is intimately connected to the concepts of moral hazard and adverse selection in economic theory, introduces a market failure that may be mitigated through carefully crafted institutions.

The example of commercial buildings shows that the notions of imperfect information and bounded rationality as applied to household behavior may be generalized somewhat to explain inefficiencies in business-to-business transactions. Commercial tenants are often small firms operated by a single proprietor or group of individuals lacking expertise in facilities management. Decision-making in this context is closely analogous to questions of consumer choice, in which energy costs, as a small share of household or business expenses, are often overlooked despite agents' general interest in cost savings.

The consumer choice analogy, however, does not extend easily to consider the failure of costeffective energy-efficient technologies to gain ready acceptance in vertically integrated corporations, where costs and benefits are (in principle) consolidated in a unified accounting system and where facilities and operations management is a professional task. Yet even in this context evidence of an efficiency gap is relatively well-demonstrated (DeCanio, 1993). Ross (1986), for example, finds that the practice of *capital rationing* — the restriction of funds available to implement small projects that lead to improved productivity or reduced costs — serves to impede the adoption of energy-efficient technologies in manufacturing firms. According to Ross, firms commonly employ "hurdle rates" of 35 to 60 % per year in the evaluation of investments in energy efficiency.

The Green Lights Program of the U.S. Environmental Protection Agency (USEPA), which facilitates the adoption of energy-efficient lighting systems, sheds further light on the barriers to implementing energy-efficient technologies in major corporations. Green Lights is structured as a voluntary compliance program in which firms enter into contracts with USEPA that commit them to implement lighting technologies that satisfy cost-effectiveness criteria established by agency staff. USEPA provides software and technical assistance that allow firms to achieve cost savings that were unrealized in advance of policy intervention. In addition, participation in Green Lights aids corporations in promoting an image of concern for pollution prevention and environmental conservation. DeCanio and Watkins (1998) find that the average project undertaken under this program yields an internal rate of return of roughly 45 % per year – a level of profitability that far exceeds the returns available on conventional investments.

Why do firms need USEPA to point out and encourage behaviors that have internal rates of return of 45%? Why don't firms automatically identify and exploit these opportunities? These questions are important for three reasons. First, if firms' failure to independently identify and exploit profitable energy-efficiency opportunities have a common root cause, it may be remediable through a single mechanism or set of mechanisms. Second, a rigorous understanding of how Green Lights and related programs have achieved their results would enable policy-makers both to refine and improve existing programs, as well as to identify new opportunities for similar programs. And third, to the extent that plausible explanations lie outside the main stem of neoclassical economics, this problem presents an opportunity to expand the applications of alternative approaches to the study of economics into the broader field of energy analysis and policy.

This paper aims to address all three of these reasons for examining the efficiency-gap question

and the role of voluntary compliance programs. The paper lays out a theoretical approach that will help identify on a micro-level what aspects of voluntary compliance programs give them their "kick," and where, how, and why they have an effect on firms. We begin by discussing what we mean by a privatesector "firm." With reference to voluntary-compliance programs such as USEPA's Energy Star program, we then present a framework of economic theory that we believe will lead to new insights on the problem under consideration. We conclude by sketching the potential implications of revised theories of the firm for policies to promote energy efficiency and reduced energy use.

Definitions of the Firm

Neoclassical economics represents firms as monolithic actors that consistently minimize costs and maximize profits, with strong incentives to improve corporate performance. Market opportunities, defined by prices, motivate and determine firm behavior. But if market prices were the sole or primary determinants of such activities as choices of technologies (and their energy-use implications), then, as Loasby (1976) points out, the firm as an independent unit of study would not exist. Research focus moves instead towards determinants of prices, including market-structure issues such as monopoly, barriers to entry, and availability of complementary and substitute products.

More recent definitions of firms offer an intra-firm perspective that is useful in understanding the success of voluntary compliance programs. For example, one can describé the firm as an organizational form that supersedes the price mechanism. Coase (1937) portrays the firm as an alternative to pure market buy/sell relationships within which economic relationships and activities are coordinated by an entrepreneurial manager. The organizational structure of a firm is chosen when it is a less costly way (as compared to a market) of achieving the desired economic end. As with the neoclassical conception, the firm is understood in large part by activities and institutions occurring beyond its formal borders. While the neoclassical conception stresses prices, this "transaction cost" conception focuses attention on the determinants of transaction costs: the range of social, cultural, and legal institutions that facilitate and inhibit market exchange, the economic organization of up- and down-stream collaborators and competitors, and related factors.

Related conceptions of the firm have been posited in recent decades. Firms can be defined as a "collection of resources" (Penrose, 1959), a definition that opens a discussion of the managerial role of adding, divesting, organizing, and mobilizing resources in a productive manner. "Resource-based strategy" could use this notion to help explain differences in firms' adoption of energy-efficient technologies, focusing, for example, on the individual firm and its opportunities for generating rents (Collis and Montgomery, 1997; Mahoney and Pandian, 1992). Firms in the same industry may earn rents in different ways, by exploiting different relationships, capabilities and attributes of their products and services.

At least four categories of resources — physical capital, human capital, organizational capital, and reputation — can influence the rate at which firms adopt energy-efficient technologies. *Physical capital* includes plant, equipment, geographic location, and access to raw materials. *Human capital* includes training, experience, values, judgment, intelligence, and insight of individual employees. *Organizational capital* includes a firm's formal structure, its planning processes, its mechanisms for controlling and coordinating its systems, and informal relationships. *Reputation* includes trust developed within specific business relationships, as well as general perceptions held by investors and the general public. *Core capabilities* are combinations of the four types of capital that allow a firm to perform business functions that address strategic opportunities (Teece *et al.*, 1997).

A resource-based description of firm behavior might note that firms in industries with slow turnover in capital equipment may resist adopting energy-saving technologies because of the high cost of retrofitting existing equipment, while firms in industries with high rates of reinvestment may routinely incorporate energy savings with each new round of technology. Similarly, a firm with capabilities that allow it to sell differentiated products (for example, consumer electronics or personal-care products) might be likely to market energy-efficient products aggressively, if it perceived a chance to gain competitive advantage. Concern for maintaining positive reputations may lead even laggard firms to invest in energy efficiencies if public or customer concern over climate change increases.

Another approach to defining a firm is to identify it as a combination of strategy, structure, and core capabilities (Nelson, 1994). This approach, emerging from evolutionary economics, opens up avenues of investigation with respect to a firm's culture and routines, and their implications for technology choices and, ultimately, energy use. Strategy refers to the commitments a firm has made to a set of objectives, and how it intends to achieve those objectives.

A firm's structure refers to how it is set up to execute its strategy. Structure is linked to the concept of routines, since a firm's strategy determines who takes responsibility for the definition and execution of routines. Firms, Nelson believes, have "a hierarchy of practiced routines," that constitute their core capabilities. One core capability, for example, could be in the realm of research and development, where routines have been established that yield competitive-product outcomes. A firm's capabilities and routines, however can become *core rigidities* that inhibit the firm's adaptation to changing circumstances (Leonard-Barton, 1995). Capabilities and routines are assembled over time through a process of organizational learning that may be difficult to redirect.

The notion of routines takes on added importance in understanding the firm and its role in society, since routines relate not only to the internal culture of the firm, but also to the society's prevailing beliefs and institutions. This relationship between internal routines and prevailing (external) beliefs and institutions is apposite to this discussion given the *voluntary* nature of the programs under consideration in this paper.

Neoclassical and Alternative Assumptions about the Firm

The institutionalist approach to economics extends back to Thorstein Veblen (1899), John Commons (1934), and others writing in the early decades of this century. What has evolved into the *new institutional economics* is a body of literature deeply concerned with economic policy. This approach considers the economy as it exists in the context of social processes, of which deliberate policy is a dominant influence (Hayden, 1994). Furthermore, institutionalists stress realism in problem definition and model-formation, while also taking a micro-analytic approach, believing that solutions to given problems are to be found in their details.

In this section, we describe three categories of assumptions concerning the nature of the firm that are common to the neoclassical framework. Under each category, we present alternative institutionalist assumptions and some implications the alternatives may have in understanding the efficiency-gap and voluntary-compliance puzzles.

Rational, Maximizing Behavior of Individuals

This cornerstone assumption of the neoclassical framework has three elements. Humans are *rational* in the sense that they are able to calculate effectively a detailed economic plan given the

information at their disposal. This assumption was challenged by Herbert Simon (1957) who proposed the alternative of "bounded rationality," meaning that economic actors were intendedly rational, but were limited in their cognitive abilities. As the complexity of an economic question grows, so too would the potential for error in calculation. Simon's reconceptualization of the cognitive limits of economic actors links effectively with the concept of the routine, mentioned above, since a firm's routines take on added importance if there are important limits to its ability to identify, grasp, and act on new information or economic opportunities. Effective routines take full advantage of a firm's cognitive powers, improving its competitive position with respect to firms with less effective routines.

The second element, which has important implications for the neoclassical approach to economic modeling, concerns *maximizing* behavior. This assumption has been challenged and extended in several respects. First, alternatives to maximization as a goal have been offered, including *satisficing*, or comparing one's performance to that of a peer group, and aiming for credible performance in that context.

Another challenge involves the recognition that the maximizing behavior of an individual within a firm may not be consistent with the maximizing behavior of the firm as a whole. This challenge identifies at least two categories of organizational barriers to change: principal-agent and horizontal-coordination problems.

A large body of managerial literature has emerged dealing with the *principal-agent* problem (Eisenhardt, 1989; Levinthal, 1988). This literature recognizes that the fundamental organizing principles of the modern corporation — separation of ownership (shareholders) from control (professional managers) — creates opportunities for misalignment of incentives. Principal-agent problems — differences in motivations between firm managers and the owners that hire them — may limit a firm's vigilance in searching for cost-saving opportunities. For example, a risk-averse manager may not promote a relatively high-risk strategy, fearing its impacts on his or her own career, even though that strategy would be in the best interests of the firm. These tensions might cause managers to avoid the potential disruption that could accompany complex changes in routines to reduce energy use (Panayotou and Zinnes, 1995). Similarly, firms that are horizontally disaggregated into separate departments with separate objectives and accountability for performance (e.g. departments of research and development, marketing, production, etc.) face complex coordination problems when costly actions and financial rewards from the action attach to separate departments.

A further critique of the maximization assumption notes that maximizing behavior should not be a starting point for analysis. That is, maximizing behavior on the part of economic actors could be seen as a response to an economic system that calls for such behavior. Sociological and anthropological perspectives would argue that individuals bring a broader and more complex set of values to the workplace than can be encompassed by the concept of maximization per se. These values include compassion and equity, for example. An evolutionary-economics perspective would view maximizing behavior as an endogenous (or co-evolutionary) response to existing economic institutions, not an exogenous parameter that shapes economic institutions.

The third element involves a focus on the *individual* as the unit of analysis. Although economic models do not require that an individual be understood as a single person, modeling usually proceeds in that manner. Critiques that stress the importance of family and community to self-identification have been leveled at the "methodological individualism" of the neoclassical approach.

With respect to the efficiency-gap problem, alternatives to methodological individualism offer a number of new avenues of exploration. For example, a firm's routines may be hindering its ability to identify and react to economic opportunities involving energy efficiency. Similarly, from a principal-

agent perspective, the activities that promote a firm's overall performance may not benefit, or may even put at risk, the welfare of individuals charged with the decision to execute efficiency-enhancing changes. Further, the horizontal-coordination problem complicates approval for certain energy-efficiency investments due to the separation of costs and benefits.

In terms of voluntary-compliance questions, alternatives to the neoclassical paradigm create opportunities to explore internal relationships within a firm, including corporate culture. Culture, understood as regular patterns of behavior, can form a basis for implicit contracts or sets of expectations that extend beyond formal or legal requirements of the work place. In this milieu, voluntary compliance with environmental performance standards could find both champions and a receptive audience among the work force. The focus on direct accounting of profitability is relaxed as the importance of such programs to the firm *as a whole* becomes more clear.

Movement Toward Equilibrium

Neoclassical scholarship focuses to a significant degree on the conditions necessary to achieve economic equilibria. The ideal equilibrium involves full utilization of an economy's resources in an efficient manner, as well as the condition that the actions of the economy's actors are consistent and reinforcing (Nelson, 1995).

Evolutionary economics offers one of the most significant alternatives, to date, to equilibriumbased research, drawing on concepts from the biological literature on evolution by natural selection. This approach sees economic institutions, including firms, as evolving in response to a myriad of influences, such as technology, social change, and resource availability. In place of a focus on modeled equilibrium as a source of predictive power, evolutionary economics focuses on the causes of economic change. The evolutionary process is understood, for example, to include the notion of path dependency. That is, periods of unpredictable growth and change in economies and technologies culminate with establishment of design or performance standards that lock players into a particular path. What follows is a period of relatively predictable change (Arthur, 1996). Examples include the establishment of MS-DOS as the standard operating system of PC-based computing in the 1980s, as well as the acceptance of the VHS format for the video industry. The act of industry-wide adoption of a uniform standard creates its own economic benefits, sometimes called "network externalities," since firms can capture economies of scope in research and recruiting, and economies of scale in communication, procurement, and other areas. Path dependency does not suggest a unique end-point, however, but rather a direction an industrial sector is likely to follow until forces arise strong enough to induce significant change.

Evolutionary economics creates a way of thinking that could effectively frame government intervention with respect to the efficiency gap and to voluntary compliance. If a particular industrial sector is following a path that is not capturing potential energy savings, government could play a role in fostering conditions that alter that path. Once altered, the new energy-efficient path may be adopted by additional firms and new entrants with little additional effort expended by the government.

The Role of Information

The neoclassical conception of information includes two aspects. First, in line with the assumption of methodological individualism discussed above, information gathering and evaluation is considered to be an individual process. Second, the starting point for neoclassical inquiry involves information that is abundant, correct, and cost-free. A common thread of neoclassical research involves

applying constraints on information and then modeling outcomes.

One alternative conception with respect to information involves what could be called *methodological collectivism* (Babe, 1994). A collectivist approach recognizes that much information and knowledge is shared, and that their formation is a shared social process. Another departure from the neoclassical paradigm describes information gathering and processing as dynamic and explicitly evolutionary. This conception has implications for key elements of the firm described above — strategy, structure, and core capabilities — since each element is influenced by and influences the kind and structure of information gathered.

These alternative ways of thinking about information suggest new roles for government in generating and transmitting information to firms and creating voluntary-compliance programs to help address the efficiency-gap problem. Government agencies, for example, may at times be in a unique position to articulate and communicate messages regarding energy-based decision-making to higher levels of a corporation than might be achieved using internal pathways. Indeed, by focusing an energy-related message high enough in a firm's hierarchy, previously-mentioned horizontal coordination problems can be overcome.

From Theory to Application

We began this paper with the observation that private-sector firms, like households, sometimes fail to adopt investments in energy-efficient technologies that are cost-effective when judged by standard cash-flow criteria. This observation provides *prima facie* evidence that firms fail to allocate resources in a fully efficient manner, suggesting a possible role for public policies that simultaneously save energy and reduce the cost of production activities.

The notion that firms fail to minimize costs or maximize profits is inconsistent with the standard theory of the firm, in which businesses are represented as well-informed monolithic actors with strong incentives to exploit opportunities for improved performance. The discussion presented above, however, establishes that a range of recent innovations in economic theory – institutional economics, transaction cost economics, evolutionary economics, and resource-based strategy – can account for the fact that businesses are both profit-oriented and yet less than perfect in promoting the goals of shareholders and management.

These new theoretical approaches expand the range and scope of possible efficient public policies by explaining mechanisms for influencing firms that the neoclassical approach overlooked by assuming that firms behave as economically "rational" actors. New definitions of the private-sector firm, combined with recent research and insights concerning bounded rationality, path-dependence, routines, and the external competitive and regulatory environment have lent new realism to descriptions of firms and firm behavior, and have created new grounds for investigating the impacts of such programs as Energy Star and Green Lights.

Understanding business strategies from a resource-based perspective may permit us to identify the underlying barriers within the firm that need to be addressed to promote energy efficiency. Differences among industries in resource investments may signal a need for diversity in policy interventions. For example, simply providing information and technical assistance may be sufficient to drive change in industries with relatively rapid turnover of capital assets (e.g., semiconductor fabrication or manufacturing). Conversely, in industries with relatively slow rates of capital asset turnover (e.g., pulp and paper), tax-based incentives to modernize equipment may be required. Inter-firm differences within a single industry may indicate a need for a suite of policy interventions to address differing resource-based concerns. These might include tax incentives that encourage technology leaders to development new energy-efficient products, along with reporting requirements to promote energy-efficiency in reputation-conscious firms.

One should not, however, assume that the mere existence of market failures implies that government intervention will improve the efficiency of resource allocation. It is one thing to identify the *technical potential* for cost-effective energy efficiency improvements and quite another to achieve this potential through the design of effective institutions. Economic theory suggests that policy solutions should be matched to the specific market failures that characterize the problem at stake (Friedman, 1984). In some cases the cure of activist policies might be more costly than the disease of departures from the idealized assumptions of profit maximization. With this in mind, it is essential to conduct detailed case studies of the institutional barriers that impede the adoption of energy-efficiency improvements and to carefully document the costs and benefits of policy solutions.

In terms of applications of our framework, the success of Green Lights, which is documented by DeCanio and Watkins (1998), is in our view based on USEPA's ability to provide to firms credible information that was previously overlooked by business strategies and corporate routines. In part, this could have been due to horizontal-coordination problems. For Green Lights, actions by a government agency reduced the transaction costs that impeded the adoption of clearly desirable technologies both by vouching for the credibility of the technologies as well as by identifying win-win investments at a level of firms' hierarchies where horizontal-coordination problems no longer obstructed an efficient outcome. Our hypothesis could be tested by examining at what level decisions to join the Green Lights program have been made for participating firms.

In a similar vein, USEPA's Energy Star Program has targeted, among other products, the production of computer components, offering the agency's seal of approval to equipment that meets energy performance-standards. Our preliminary review of the Energy Star program suggests that it has been successful. Explanations of its success could arise from definitions of the firm that capture effectively the importance of employees' values in shaping corporate culture and decision-making. To pursue this line of research, one would posit hypotheses about labor markets and company/employee relationships and then compare the extent of adoption of Energy Star standards between participating industries that differ in those regards. From another perspective, the rate of adoption of Energy Star standards could by analyzed in the context of a network externality-based explanation of consumer choice. That is, if only one offering in a class of products displays the Energy Star label, customers may then view the label as a desirable standard and will be less inclined to purchase an offering that does not have the label. In future research, we plan to employ the theoretical framework presented here in an effort to identify what elements of the Energy Star program are responsible for its success and in what kinds of industries the program is most likely to be effective.

References

Arthur, W. 1996. "Increasing Returns and the New World of Business." Harvard Business Review 74(4): 100-109.

Babe, R. 1994. "Information Theory in Economics." In The Elgar Companion to Institutional and Evolutionary Economics (G. Hodgson, W. Samuels and M. Tool, editors). Brookfield, Vermont: Edward Elgar.

Coase, R. 1937. "The Nature of the Firm." Economica 4: 386-405.

Collis, D. and C. Montgomery. 1997. Corporate Strategy: Resources and the Scope of the Firm. Chicago, Irwin, McGraw-Hill.

Commons, J. 1934. Institutional Economics. Madison: University of Wisconsin Press.

DeCanio, S. 1993. "Barriers within Firms to Energy-Efficient Investments." Energy Policy 21: 906-914.

DeCanio, S. and W. Watkins. 1998. "Investment in Energy Efficiency: Do the Characteristics of Firms Matter?" Review of Economics and Statistics 80: 95-107.

Eisenhardt, K. 1989. "Agency Theory: An Assessment and Review." Academy of Management Review 14: 57-74.

Friedman, L. 1984. Microeconomic Policy Analysis. New York: McGraw-Hill.

Hayden, F. 1994. "Institutional Theory of Economic Policy." In The Elgar Companion to Institutional and Evolutionary Economics (G. Hodgson, W. Samuels, and M. Tool, editors). Brookfield, Vermont: Edward Elgar.

Howarth, R. and A. Sanstad. 1995. "Discount Rates and Energy Efficiency." Contemporary Economic Policy 13: 101-109.

Intergovernmental Panel on Climate Change. 1996. Climate Change 1995: Economic and Social Dimensions of Climate Change. New York: Cambridge University Press.

Interlaboratory Working Group. 1997. Scenarios of U.S. Carbon Reductions: Potential Impacts of Energy Technologies by 2010 and Beyond. Berkeley: Lawrence Berkeley National Laboratory.

Leonard-Barton, D. 1995. Wellsprings of Knowledge: Building and Sustaining the Sources of Innovation. Boston: Harvard Business School Press.

Levinthal, D. 1988. "A Survey of Agency Models of Organizations." Journal of Economic Behavior and Organization 9: 153-185.

Loasby, B. 1976. Choice, Complexity, and Ignorance. New York: Cambridge University Press.

Mahoney, J. and J. Pandian 1992. "The Resource-Based View Within the Conversation of Strategic Management." Strategic Management Journal 13: 363-380.

Nelson, R. 1994. "Theory of the Firm (II)." In The Elgar Companion to Institutional and Evolutionary Economics (G. Hodgson, W. Samuels, and M. Tool, editors). Brookfield, Vermont: Edward Elgar.

Nelson, R. 1995. "Recent Evolutionary Theorizing about Economic Change." Journal of Economic Literature 33(1): 48:90.

Panayotou, T. and C. Zinnes. 1994. "Free-Lunch Economics for Industrial Ecologists," in Industrial Ecology and Global Change. (R. Socolow, et. al., editors.) New York: Cambridge University Press.

Penrose, E. 1959. The Theory of the Growth of the Firm. Oxford: Blackwell.

Ross, M. 1986. "Capital Budgeting Practices of Twelve Large Manufacturers." Financial Management 15: 15-22.

Sanstad, A., and R. Howarth 1994. "Consumer Rationality, Energy Analysis, and Policy." In ACEEE Summer Study on Energy Efficiency in Buildings.

Simon, H. 1957. Models of Man. New York: John Wiley and Sons.

Teece, D., G. Pisano, and A. Shuen 1997. "Dynamic Capabilities and Strategic Management." Strategic Management Journal 18: 509-533.

U.S. National Academy of Sciences. 1991. Policy Implications of Greenhouse Warming: Report of the Mitigation Panel. Washington: National Academy Press.

Veblen, T. 1899. Theory of the Leisure Class. New York: MacMillan.