

Some Microeconomics of Eco-Entrepreneurship

By Matthew J. Kotchen*

1. Introduction

A growing academic literature seeks to define corporate environmental management (CEM) and understand its implications for corporate behavior and environmental outcomes. But the research questions are of more than academic interest, as the answers have immediate consequences for business strategy, environmental quality, and the relationship between CEM and public policy. How does CEM differ from more general notions of corporate management? Are there incentives for CEM that go beyond improving the bottom line? Does CEM produce genuine improvements in environmental performance, or is it simply a public relations form of “green-washing”? To what extent, if any, does CEM serve as a complement or substitute for more centralized forms of environmental policy? Questions such as these are the focus of theoretical and applied research in a variety of disciplines, including, but not limited to, economics, sociology, psychology, political science, management, and industrial ecology.

Real progress has been made to date on advancing the understanding of CEM. Examples of recent work within economics include papers by Lyon and Maxwell (2004, 2008), Portney (2008), and Reinhardt, Stavins, and Vietor (2008). One facet that has received surprisingly little attention, however, is that of entrepreneurship. Significant challenges often emerge when attempting to study the environmental performance of existing businesses. Many of these challenges are magnified even further, and a host of others emerge, when attempting to study the environmental performance of businesses not yet created. Nevertheless, the need to further understand the relationship between entrepreneurship and the environment is increasingly important. Public concern about environmental issues is on the rise—and with good reason. Along with the concern has come broad recognition of the need to further engage the private sector to help solve environmental problems. Academic researchers—and policymakers—have historically conceived of the private sector’s role in environmental management as one of agents that simply comply with regulation. More recently, the private sector is looked upon to play a more proactive role, one that many believe is essential to help meet the greatest environmental challenges.

* Kotchen is an assistant professor at the University of California, Santa Barbara and a research fellow at the National Bureau of Economic Research. Please send correspondence to kotchen@bren.ucsb.edu. This paper was written as a contribution to the conference on Frontiers of Eco-Entrepreneurship held at the Bren School of Environmental Science & Management at the University of California, Santa Barbara on May 23rd and November 7th, 2008. Financial support is gratefully acknowledged from the Ewing and Marion Kauffman Foundation.

The private sector's expanded role is immediately apparent in the context of climate change. It is widely recognized that business as usual in worldwide emissions of greenhouse gases—primarily carbon dioxide from the burning of fossil fuels—are likely to result in significant, if not catastrophic, increases in global temperatures. The fundamental problem is that modern societies have evolved in ways that are completely dependent on fossil fuels for energy. Realistically addressing the problem will thus require the innovation of new technologies that can generate energy with substantial reductions in carbon dioxide emissions. A further requirement is that these technologies be affordable and scalable in a way that can meet the world's ever increasing demand for energy. Regardless of whether the technologies currently exist or are waiting to be discovered, we also need new business models and complementary public policies that encourage innovation, distribution, and adoption. The private sector is clearly anticipating these trends and viewing them as financial opportunities. Perhaps the greatest signal of this movement is the vast amounts of venture capital flowing toward entrepreneurial activities that aim to help solve the energy-climate problem.

More generally, entrepreneurship in relation to the environment goes beyond the challenges of climate change and energy. Always on the lookout for natural compounds with medicinal benefits, pharmaceutical companies engage in ways to protect biodiversity for potential future use. Markets for ecosystem services are beginning to form based on explicit recognition that conservation yields financial dividends ranging from flood control and nutrient cycling to pollination and ecotourism. Problems associated with water quality and quantity in developing countries have created business opportunities for an array of new and simple innovations, including low-cost ceramic filters, portable filtration straws, and rolling drums that make transporting water easy and efficient. In developed countries, markets for “environmentally friendly” consumer products are expanding rapidly, as demonstrated by the surge in green building practices, which aim to create healthier living spaces, in addition to improving energy efficiency. Finally, new technologies are always in demand for better ways of addressing pollution, such more effective techniques for the cleanup of oil spills, the scrubbing of smokestack emissions, and the remediation of contaminated aquifers.

In this paper, I broadly categorize entrepreneurial activity with a clear linkage to environmental protection as “eco-entrepreneurship” and take the following question as a starting point: Is eco-entrepreneurship different from entrepreneurship? I argue that while eco-entrepreneurship is a subset of entrepreneurship more generally conceived, the focus on “eco” highlights particular opportunities that are expanding and of interest to a new generation of potential entrepreneurs. The distinguishing feature of eco-entrepreneurship, as I will show, is joint production that includes a positive environmental externality. After defining eco-entrepreneurship more formally, I consider three case studies: Waterless Company, Sea Breeze Power Corporation, and Mica-Tech Incorporated. In each case, I provide a brief description of the company and analyze it as an example of eco-entrepreneurship. Together, the case studies identify different mechanisms whereby eco-entrepreneurship can emerge: the shifting of tastes and preferences, changing public poli-

cies, and advancements in technology. In the end, my aim is to contribute a basic micro-economics perspective to the emerging and increasingly important field of eco-entrepreneurship.

2. What is Eco-Entrepreneurship?

The first step towards establishing a formal definition of eco-entrepreneurship (hereafter referred to as EE) is to specify a basic definition of entrepreneurship. But even this is not an easy task. Though we might recognize entrepreneurship when we see it, defining its precise meaning has been the subject of a long and controversial literature that spans centuries of scholarship. Here I intend to keep things simple and employ the following definition:

Definition 1: *Entrepreneurship is the practice of starting new businesses in response to an identified opportunity to earn a profit.*

How then is EE different? In one respect I think it is not. Entrepreneurial activity of any type is subject to the constraint of financial viability, at least in the long run. Any new business—even one considered part of EE—must eventually earn a profit, otherwise it will be driven out of the market. But we can think of EE as differing with respect to a narrowing of the types of opportunities upon which it is based. In particular, EE focuses on opportunities that also provide environmental benefits, and these may arise because the business produces a good or service that improves environmental quality, or at least minimizes adverse impacts relative to competitors. Combining the ideas of profitability and environmental benefits, I propose the following definition:

Definition 2: *Eco-entrepreneurship is the practice of starting new businesses in response to an identified opportunity to earn a profit and provide (minimize) a positive (negative) environmental externality.*

Fundamental to EE, therefore, is the notion of an externality, which itself is defined as a benefit or cost experienced by those not directly involved in an economic transaction. Environmental benefits arising from EE will generally satisfy this criteria. Consider, for example, a good associated with greater energy efficiency and therefore reduced carbon dioxide emissions. The individual purchasing the good may enjoy a cost savings—which may, or may not, be the primary reason for the purchase—but the benefits of reduced emissions are enjoyed by all individuals because less carbon dioxide in the atmosphere will help minimize the impacts of climate change.

In many cases, the environmental externality arising from EE will be a public good, meaning that all individuals can enjoy the benefits, and each individual's enjoyment does not diminish the enjoyment of others. This observation leads to a complementary definition:

Definition 3: *Eco-entrepreneurship is the practice of starting new businesses that are profitable and based on goods or services that are impure public goods with environmental benefits.*

In this context, the distinguishing feature of the impure public good is joint production of a private good and an environmental public good (see Cornes and Sandler 1984, 1994, and Kotchen 2005, 2006). Consider, for example, the growing market for green electricity, which is electricity generated with renewable sources of energy. Consumers increasingly have the option to purchase green electricity with a price premium that applies to all or part of their household's electricity consumption. In return, production of green electricity displaces pollution emissions from electricity generated with fossil fuels. Thus consumers of green electricity purchase a joint product—electricity consumption and reduced emissions. Another example is the growing market for premium-priced, shade-grown coffee, which is coffee grown under the canopy of tropical forests rather than in open, deforested fields. Shade-grown coffee plantations provide important refuges for tropical biodiversity, including migratory birds. Thus consumers of shade-grown coffee also purchase a joint product—coffee consumption and biodiversity conservation.

It is clear from our definitions that EE is a subset of entrepreneurship in general. Entrepreneurs seek opportunities to earn a profit, and it matters not whether the opportunity generates a positive externality or is based on production of an impure public good. Hence, any opportunity for EE should also be of interest to all entrepreneurs, regardless of whether they have a particular concern for the environment. The implicit assumption here is that required rates of return for EE are the same as that for entrepreneurship in general. Determining whether this assumption holds in practice, however, is an important question for future research. But assuming that the required rate of return is the same, we conclude that irrespective of any “eco” dimension, a good business opportunity is a good business opportunity.

Why then, we might ask, is the EE distinction useful? The question is important, and I think related to the standard line economists have about dollar bills lying on the sidewalk: there are none. The idea is that someone will always pick them up. Opportunities to make a profit are equivalent to dollar bills laying on the sidewalk, and someone will always take advantage of a profitable business opportunity. One might argue, therefore, that the EE distinction is unnecessary because taking advantage of any profitable new business venture is what entrepreneurship is all about.

While the critique that EE is no different from entrepreneurship in general has a clear foundation in microeconomic reasoning, I would argue that the distinction remains useful and important for several reasons. First, I have found dollar bills on the sidewalk—even higher denominations—and I bet you have too. Over time it may hold that all profitable opportunities will be taken advantage of, but in the short run, opportunities clearly exist, and someone must be the person to seize them. If this were not the case, there would be

no reason to study entrepreneurship or for it to play such an important role in the curriculum of business schools, and clearly it does.

Second, the dynamics of perfectly competitive markets are different than the dynamics of entrepreneurship. In the standard model of a perfectly competitive market, ease of entry implies that profitable opportunities will quickly dissipate, as new firms respond by entering the market. But this conclusion is based on the assumption that new firms replicate the technologies and know-how of existing firms. Entrepreneurship, in contrast, tends to focus on the creation of something new and not entirely anticipated; it is more of a creative process. And eco-entrepreneurs are different still. While entrepreneurs seek out new and creative ways to earn a profit, the typical eco-entrepreneur first thinks about ways to help protect the environment, then asks whether the ideas can be profitable. In a context where most innovations are new and experimental, these different approaches can result in different and unanticipated outcomes. There are path dependencies in the way that we solve problems.

Third, economists rarely advocate a role for government when there is no market failure, which is a scenario that does not apply to EE. Because the output of EE is associated with a positive externality, minimizing a negative externality, or providing a public good, microeconomic theory shows that the amount of EE activity will be inefficiently low. This is a market failure that arises with EE, but need not with entrepreneurship in general. The intuition for suboptimal EE straightforward: likely eco-entrepreneurs will not capitalize on all the societal benefits of their endeavors and thus have less incentive to pursue them than would be most beneficial to society as a whole. This, in turn, provides a justification for governmental policy designed to encourage EE, with possible instruments ranging from grants, subsidies, favorable tax treatment, and even assurances of product demand.

We have now established working definitions of EE and argued that the distinction is useful and important. All forms of successful entrepreneurship must be financially viable, but EE is distinct because it generates environmental benefits as well. While eco-entrepreneurs are likely to bring a unique perspective because their concern for the environment, the more important driver is that profitable opportunities exist. With this framework in place, let us now turn to three case studies of successful EE.

3. Waterless Company

Waterless Company has been operating since 1991 and is one of the industry leaders in the production of urinals that do not require flushing—that is, they are waterless. A key feature of the urinals is the patented EcoTrap®. The technology enables urine to flow through the drain while preventing sewer vapor from escaping, which is the major challenge of having waterless plumbing indoors. The selling point of a waterless urinal is, of course, water conservation. It is estimated that a waterless urinal saves up to 45,000 gallons of water per year. With fresh water resources becoming increasingly scarce, often due to increasing demand, these urinals provide the joint product of, well, as place to uri-

nate, cost savings on water bills, and water conservation (a public good). Waterless urinals are therefore impure public goods. Though the company appears to have struggled for many years, business has recently turned, and Waterless Company has become a successful example of EE.

In order to understand the recent success of Waterless Company, we need to understand the recent increase in demand for waterless urinals. Microeconomic theory tells us that three things can cause a shift in demand: changes in income, changes in the price of complements or substitutes, and changes in tastes and preferences. It is hard to believe that any changes in income, either positive or negative in recent years, has had a measurable effect on demand for waterless urinals. It is easier to believe that the price of water—a substitute through use in flush urinals—could have an effect on demand for waterless urinals, whereby an increase in the price of water causes an increase in demand. But my sense is that water prices, which are often very low to begin with, have not changed substantially enough in recent years to explain the expanding market for waterless urinals.

We are thus left to consider changes in tastes and preferences, and this is where I think the most action has occurred. In recent years we have seen unprecedented awareness and concern about environmental issues, and one consequence has been the expansion of demand for more environmentally friendly goods and services. One of the industries in which the shift has been particularly noticeable is green buildings, which are designed to use fewer resources, emit fewer pollutants, and create healthier spaces. Water conservation is an important consideration, and waterless urinals can make an obvious contribution. Unlike many other design features, the installation of waterless urinals also has the advantage of being observable. Buildings with waterless urinals frequently have signs drawing attention to them and educating users about the water conservation benefits. In other words, more often than not, the installation of waterless urinals comes with favorable public relations. Not surprisingly, research has found that such reputation benefits influence the purchase of environmentally friendly goods and services (e.g., Kahn 2008, and Kotchen and Moore 2008).

A related trend, in the sense of public relations and spurring demand, is the widespread adoption of green certification. The U.S Green Building Council's Leadership in Energy and Environmental Design (LEED) rating system has become the dominant player regarding the certification of green buildings. LEED provides third-party certification that construction practices and design features meet various gradations of environmental performance. Certification requires that buildings meet predefined criteria, and there are recommendations for the adoption of specific technologies. Fortunately for Waterless Company, waterless urinals are among them, and this has without a doubt caused an increase in demand that is likely to continue as LEED certification grows even more popular.

In sum, the case of Waterless Company began with a technological innovation. But this was not sufficient for successful EE, as there needed to be demand for the product. When a shift in tastes and preferences and the expansion of third-party certification caused an

increase in demand for waterless urinals, Waterless Company, perhaps foreseeing the eventual turn, was there to capitalize after years of struggling to survive. Now the company has the advantages of being an early mover in the industry and enjoying the benefits of brand recognition. Prospects for the future are also good, as water resources are only likely to grow more scarce, and green building practices appear here to stay.

4. Sea Breeze Power Corporation

Sea Breeze Power Corporation is a Vancouver-based company that seeks to take advantage of British Columbia's renewable energy potential. According to the company mission statement, its "external goal is to serve a leadership role in expanding widespread adoption of utility-scale renewable energy." As part of this effort, "Sea Breeze is presently engaged in the development of utility-scale wind farms, 'run-of-river' hydroelectric projects, and through joint venture partnerships, the development of state-of-the-art electricity transmission projects." Generally speaking, the portfolio of Sea Breeze projects are designed to take advantage of British Columbia's natural endowments for generating renewable energy and to overcome the challenges of delivering this energy to distant locations where demand is high.

As discussed previously, one of the most significant environmental problems that we face arises because of the linkage between the world's increasing demand for energy and climate change. It is widely believed that any attempt to realistically tackle the problem requires increased reliance on renewable sources of energy, including solar, wind, and hydro power. But as efforts to upscale the use of renewables for electricity generation have begun, the disconnect between places where generation is most efficient and places where the electricity is needed is emerging as a significant barrier. For instance, many of the most productive sites for wind power in North America are along the U.S.-Canadian border, but this is not where electricity demand is greatest. Further compounding the problem are barriers within the existing grid system for electricity transmission and significant line losses of power that occur when sending electricity over long distances.

These challenges provide the EE opportunity for Sea Breeze Power Corporation. Taking advantage of British Columbia's vast potential for wind energy and run-of-river hydroelectric development, the company has projects covering 180,000 hectares on some of the regions most desirable sites. What is more, Sea Breeze has obtained approvals for additional wind and hydroelectric projects that are considered significant achievements for further development of the area's natural resources. In terms of transmission, Sea Breeze has several projects underway, notably the West Coast Cable, which is 1,600 megawatt transmission cable proposed to stretch 650 miles from Portland, Oregon to the San Francisco Bay Area. The project is ambitious and will be the world's longest high-voltage direct current submarine cable.

The aim of the West Coast Cable Project is to connect regions of energy supply and demand in order to promote the growth of clean energy generation in the Northwest. Con-

struction of the cable infrastructure will enable Sea Breeze to take further advantage of its abundant renewable resources. This is possible to a large extent because of advanced cable technology. The cable will be constructed out of environmentally friendly transmission technology that provides up to 75 percent lower line losses over long distances than other existing technologies. The Sea Breeze combination of energy production from renewable resources and expanded transmission capacity is consistent with an EE strategy that seeks to exploit comparative advantage (generation) through partnerships based on technology and infrastructure expansion (cable construction).

But just as we saw in the case of Waterless Company, supply is not sufficient for successful EE without demand. We should then ask: what are the drivers of demand here? One contributing factor is that demand for electricity is certain to increase in coming years, implying that all sources of generation that are reasonably price competitive will be in demand. More importantly, however, Sea Breeze provides an example of EE in response to existing and anticipated environmental policy. In particular, many policies within the United States serve to increase demand for electricity generated from renewable sources of energy, including the following: (1) higher costs of generating electricity with fossil fuels because of emission regulations; (2) the establishment of renewable portfolio standards (RPS) on a state-by-state basis; (3) the phase in of carbon dioxide emission reductions as part of climate change policies (e.g., California's AB 32); and (4) a general reluctance to construct new, large-scale power plants in the U.S. because of aversion to pollution emissions and the creation of nuclear waste.

The existence of these policies and trends has created—and will continue to create—an opportunity for Sea Breeze Power Corporation. While securing generation capacity and investing in large-scale transmission infrastructure, Sea Breeze is positioning itself to take advantage of a significant EE opportunity created by an evolving regulatory environment—one that is only likely to grow more favorable to renewable sources of energy in the near future.

5. Mica-Tech Incorporated

The previous two case studies were examples of successful EE because of changes on the demand side of the market: one a shift in tastes and preferences, which also spurred the creation of third-party certification, and the other due primarily to environmental policy. The final case study, Mica-Tech Incorporated, is an example of successful EE because of a change on the supply side of the market, namely a technological innovation.

Mica-Tech is a manufacturer and marketer of satellite communication systems serving businesses and electric utilities. One application of the system is a demand response program for participating businesses. The idea is that businesses select their own electricity loads that can be curtailed during peak-power periods. Examples include reductions in air-conditioning and/or turning off lights and equipment during non-essential periods. Mica-Tech then installs technology—at no cost to the business—that links control of

these selected reductions with a secure satellite system, which enables curtailment to occur remotely based on selected criteria. The participating businesses then earn cash back not only from electricity savings, but also from incentives to participate in demand side management. Hence we have another example of an impure public good, with the joint products of energy cost savings and reduced pollution emissions. Mica-Tech's contribution in this area is also particularly worthwhile because of current debate about the effectiveness of utility-sponsored demand side management programs (e.g., Loughran and Kulick 2004, and Auffhammer, Blumstein, and Fowlie 2008).

Mica-Tech's other application of the satellite system is supervisory control and data acquisition for the management of electrical power grids. In this case, the customers are electric utilities that must manage the flow of electricity across a power grid. The satellite technology is used to accurately monitor the demand for electricity and enable grid managers to direct the flow of electrons accordingly. These applications of the system have been in operation for over a decade, and Mica-Tech makes the case that their satellite technology offers several advantages over the alternatives in terms of cost, maintenance, and reliability.

Mica-Tech has done very well with this technology, having recently been acquired as a subsidiary of AML Communications, Incorporated. But beyond its entrepreneurial success, there is a clear "eco" dimension to the business. Managing an electricity grid more efficiently means less wasted electricity and therefore fewer emissions, as indicated above, and the same holds for demand response programs. What is more, both applications of the technology can reduce demand for construction of new power plants, and because loads can be spread more evenly, generation can be smoothed so that existing plants can run more efficiently.

The success of Mica-Tech is clearly the result of a technological innovation that created a new opportunity for EE. The company was based on the insight that satellite technology, as used in Global Positioning System applications, could also be used in a different context, to solve other problems. Given the rapid pace of technological innovation, opportunities of this type are continually emerging. There is no telling what new ideas will come next, but we can all keep our eyes open for the next EE opportunity, spurred by a new technology or the application of existing technology in a new context.

6. Conclusion

Entrepreneurship is one aspect of corporate environmental management that has not received much attention in the academic literature. This paper takes as its starting point the question of whether EE is different from entrepreneurship in general. I have argued that from a business opportunity perspective, EE is a subset of entrepreneurship, but I have also argued that the distinction is important. EE is defined as business opportunities that earn a profit and are also associated with generating a positive environmental externality (or public good). These opportunities exist and are often closely associated with existing

and/or anticipated environmental policies. What is more, EE is important because it frequently attracts a different type of entrepreneur, one who seeks to improve environmental quality first and foremost, and then ask whether the idea can earn a profit. This different orientation can be a powerful force in the much needed search for solutions to our most pressing environmental problems.

The three case studies discussed here provide compelling examples of successful EE. In particular, by viewing them through a microeconomics perspective, the cases are useful for identifying different mechanisms whereby EE can emerge, namely the shifting of tastes and preferences, changing public policies, advancements in technology, or new applications of existing technology. Future research that combines more rigorous theory and systematic empirical analysis will guide future eco-entrepreneurs and help shape the appropriate relationship between EE and environmental policy.

References

- Auffhammer, M., C. Blumstein, and M. Fowlie (2004). "Demand-Side Management and Energy Efficiency Revisited," *The Energy Journal*. Vol. 29, pp. 91-104.
- Cornes, R, and T. Sandler (1984). "Easy Riders, Joint Production, and Public Goods." *Economic Journal*. Vol. 94, pp. 580-598.
- Cornes, R, and T. Sandler (1994). "The Comparative Static Properties of the Impure Public Good Model." *Journal of Public Economics*. Vol. 54, pp. 403-421.
- Kahn, M. E. (2008). "Do greens drive Hummers or hybrids? Environmental ideology as a determinant of consumer choice," *Journal of Environmental Economics and Management*, Vol. 54, pp. 129-145.
- Kotchen, M. J. (2005). "Impure Public Goods and the Comparative Statics of Environmentally Friendly Consumption," *Journal of Environmental Economics and Management*, Vol. 49, pp. 281-300.
- Kotchen, M. J. (2006). "Green Markets and Private Provision of Public Goods," *Journal of Political Economy*, Vol. 114, pp. 816-34.
- Kotchen, M. J. and M. R. Moore (2008). "Conservation: From Voluntary Restraint to a Voluntary Price Premium," *Environmental and Resource Economics*. Vol. 40, pp. 195-215.
- Loughran, D. and J. Kulick (2004). "Demand Side Management and Energy Efficiency in the United States," *The Energy Journal*. Vol. 25, pp. 19-41.
- Lyon, T. P. and J. W. Maxwell (2004). *Corporate Environmentalism and Public Policy*. Cambridge, United Kingdom: Cambridge University Press.
- Lyon, T. P. and J. W. Maxwell (2008). "Corporate Social Responsibility and the Environment: A Theoretical Perspective," *Review of Environmental Economics and Policy*. Vol. 2, pp. 240 – 260.
- Portney, P. R. (2008). "The (Not So) New Corporate Social Responsibility: An Empirical Perspective," *Review of Environmental Economics and Policy*. Vol. 2, pp. 261 – 275.
- Reinhardt, F. L., R. N. Stavins, and R H. K. Vietor (2008). "Corporate Social Responsibility Through an Economic Lens," *Review of Environmental Economics and Policy*. Vol. 2, pp. 219 – 239.