



Escaping the green prison: Entrepreneurship and the creation of opportunities for sustainable development

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ARTICLE INFO

Keywords:

Sustainable development
Institutional economics
Prisoner's dilemma
Sustainable entrepreneurship
Creation entrepreneurship

ABSTRACT

While entrepreneurial activity has been an important force for social and ecological sustainability; its efficacy is dependent upon the nature of market incentives. This limitation is sometimes explained by the metaphor of the prisoner's dilemma, which we term the green prison. In this prison, entrepreneurs are compelled to environmentally degrading behavior due to the divergence between individual rewards and collective goals for sustainable development. Entrepreneurs, however, can escape from the green prison by altering or creating the institutions—norms, property rights, and legislation—that establish the incentives of competitive games. We provide a variety of evidence of such entrepreneurial action and discuss its implications for theory and practice.

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“...in the condition of mere nature, where all men are equal and judges of the justness of their own fears, he which performeth first, does but betray himself to his enemy; contrary to the right (he can never abandon) of defending his life, and means of living.” Thomas Hobbes, 1651 (from Van Mill, 2001)

1. Executive summary

Much attention has been focused on the need for sustainable development, development that meets the needs of the present without compromising the ability of future generations to meet their own needs (Brundtland, 1987). Many recent writers view entrepreneurship as the engine of sustainable development, expecting that the innovative power of entrepreneurship will bring about the next industrial revolution and a more sustainable future. In line with this characterization, the popular global vernacular now includes terms such as sustainable entrepreneurship (Dean and McMullen, 2007), green entrepreneurship (Berele, 1991), environmental entrepreneurship (Anderson and Leal, 2001; Dean and McMullen, 2007; Keogh and Polonsky, 1998), eco-preneurship (Bennett, 1991; Blue, 1990; Shaper, 2002), and social entrepreneurship (Dees, 2001).

Despite growing interest and enthusiasm for the positive role of entrepreneurs in sustainable development, existing research in economics suggests that under certain conditions, markets—and therefore, entrepreneurial activity—are unable to effectively allocate environmental and social resources (Bator, 1958; Hardin, 1968; Pigou, 1932). These limitations can often be attributed to a prisoner's dilemma problem: where even though sustainable business models may carry collective benefit (for example, to an entire industry), entrepreneurs face a disadvantage when pursuing *costly* sustainable actions, as such costs may not be borne by

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competitors (Carraro and Fragnelli, 2004; Hardin, 1968; McWhinnie, 2009; Schelling, 1978;). Under these circumstances, sustainable actions are punished rather than rewarded. We label this phenomenon “the green prison”; wherein entrepreneurs face a system of incentives that fail to encourage sustainable practices.

Transcending this type of prisoner's dilemma—what we refer to as “escaping the green prison”—involves changing the competitive rules of the game by transforming economic incentives. We argue that entrepreneurs possess the agency to develop the necessary institutions that enable the exploitation of sustainable opportunities. Such agency implies the expansion of the concept of the sustainable entrepreneur from discoverer of opportunity in extant economic structures to the creator of institutional structures that improve the competitiveness of sustainable behaviors.

Sustainable entrepreneurs transform institutions by altering and/or creating norms, property rights, and government legislation. Examples of norms developed in the realm of sustainable entrepreneurship include codes of behavior among tourism operators in Australia (Huybers and Bennett, 2003), international sustainable coffee partnerships (4C, 2009a; Muradian and Pelupessy, 2005), third-party certification programs for organic foods (Fromartz, 2006), and the nanotechnology industry's codes of conduct (Krupp and Holliday, 2005). In addition, sustainable entrepreneurs motivate the development of property rights to exploit profit opportunities and protect resources from unsustainable behavior. This is illustrated in the distribution of rights that has taken place in the Maine lobster fisheries (Acheson, 1987; Anderson and Huggins, 2003) and the assignment of rights to private land in Japan (Ostrom, 1990). Sustainable entrepreneurs may also encourage cooperative institutions through mandatory rules that are codified and enforced by governmental bodies. Legislation ensures that when individuals are not otherwise incented to act in the interest of society, they will be required to do what is collectively beneficial. Examples of the entrepreneurial encouragement of mandatory legal standards include Khosla Venture's efforts to eliminate subsidies for oil and gas companies (Little, 2006; PR Newswire, 2006), the solar energy industry's promotion of renewable energy portfolio standards (Solar Energy Industries Association, 2007), and the organic industry's lobbying for the Organic Foods Labeling Act (Fromartz, 2006).

Our analysis suggests important implications for entrepreneurs escaping the green prison. We present a variety of strategies used in such circumstances; most of which include the use of collective action through partnerships with industry and civil organizations. Using these relationships, entrepreneurs seek the implementation of collectively approved rules of conduct, third party certification schemes, the assignment of property rights, and favorable legislation that improve the competitiveness of sustainable initiatives. Important amongst these actions, is their ability to pave the way for further entrepreneurial activity that takes advantage of the institutional structure created by these sustainable entrepreneurs.

2. Introduction

Both popular and academic writers have asserted that the innovative process of entrepreneurship can serve as a central force in the development of an ecologically and socially sustainable economy (Anderson and Leal, 1997, 2001; Bennett, 1991; Blue, 1990; Dean and McMullen, 2007; Hawken, 1994; Hawken et al., 1999; Shaper, 2002). Unfortunately, theoretical and empirical research on the topic has lagged well behind both entrepreneurial activity and popular interest in the phenomenon. To date, little research on entrepreneurship and sustainable development has appeared in the academic literature and we are only just beginning to understand their relationship, let alone the complexities of the phenomenon (Dean and McMullen, 2007; Shaper, 2002).

Foremost among the issues in the study of entrepreneurship and sustainable development is the paradox between normative claims of entrepreneurship as the solution to sustainable development challenges, and research in environmental and welfare economics that emphasizes the limits to sustainable entrepreneurial action. Indeed, the assertions of sustainable entrepreneurship proponents stand in contrast to well-known theoretical prescriptions in the economics literature. Most important amongst the latter, is the conclusion that the public and non-excludable character of social and environmental resources often creates a divergence between individual and collective incentives, which is revealed in the incidence of self-interested behavior that degrades social and environmental conditions (Carraro and Fragnelli, 2004; Hardin, 1968; Tietenberg, 2000; Pigou, 1932). This conclusion raises the question of *whether and how the process of entrepreneurship can contribute to sustainability*, when a large body of research concludes that many social and environmental goods are not amenable to market allocation (see Section 3.2 for some examples) (Bator, 1958; Hardin, 1968; Carraro and Fragnelli, 2004; Cropper and Oates, 1992; McWhinnie, 2009; Pigou, 1932). The implication of this is that sustainable entrepreneurship is constrained to contexts where individual and collective incentives are aligned under the existing system of economic institutions. In contrast, in the absence of such conditions, sustainable entrepreneurship would fail to exist and fulfill its normative implications.

We suggest, however, that this conclusion is often misguided. Developments in institutional economics and entrepreneurship theory can help to explain how entrepreneurs overcome suboptimal market incentives to create sustainable entrepreneurship opportunities and enhance both global and competitive sustainability (Aldrich and Kenworthy, 1999; Alvarez and Barney, 2007; Anderson and Leal, 1997; Anderson and Leal, 2001; Langlois, 1992; North and Thomas, 1970; Sarasvathy, 2001). We follow this rationale to answer the question of whether and how entrepreneurs can engender institutional incentives to sustainable development and achieve the normative expectations implied in the concept of sustainable entrepreneurship.

Following a body of research in game theory (Axelrod, 1984; Maynard Smith and Price, 1973; Schelling, 1978), environmental economics (Carraro and Fragnelli, 2004; Osés-Eraso and Viladrich-Grau, 2007; Tietenberg, 2000), and institutional economics (Bromley, 1989; North, 1991; Schotter, 1981; Sugden, 1986), we view sustainability challenges as a prisoners' dilemma problem wherein entrepreneurs face a potential competitive disadvantage when pursuing *costly* sustainable actions, as such costs may not be borne by competitors. We refer to this entrepreneurial predicament as the “green prison”: wherein entrepreneurs are

compelled to unsustainable behavior by the process of competition, given that sustainable actions are punished, rather than rewarded.

Yet we transcend the game theory literature to introduce a more complete understanding of sustainable entrepreneurship, which lies in expanding the concept of the sustainable entrepreneur from *discoverer* of opportunity in extant economic structures to structural agent who develops institutions to change the “rules of the game” and thereby drives sustainable behaviors. We argue that entrepreneurs can *create* sustainable opportunities by proactively devising and influencing the establishment of new industry norms, property rights, and government legislation that transform the payoffs of their competitive games. This enables them to “escape from the green prison” by altering the rewards for sustainable behavior in a way that improves their competitiveness and profit potential. These actions allow entrepreneurs to create the social structure that is necessary for the growth of sustainable sectors (Kuznets, 1966; 1972). Even though technological innovation is important in promoting such growth, entrepreneurs also recognize the need to devise novel incentive systems that support new types of economic transactions (Daft, 1978; Damanpour, 1987; Kimberly and Evanisko, 1981; Kuznets, 1966; 1972).

We contribute to the literature on entrepreneurship and sustainable development in a number of ways. First, we utilize the metaphor of the prisoner’s dilemma to help communicate how entrepreneurs may change the rules of competitive games to achieve their individual interests while generating positive collective outcomes. While research in welfare and environmental economics has employed game theory and the prisoners’ dilemma to understand the external effects of corporate activity, it has generally not transcended the dilemma to propose market-based solutions to these conditions (Bimonte, 2008; McWhinnie, 2009; Osés-Eraso and Viladrich-Grau, 2007; see Ostrom, 1990, Osés-Eraso and Viladrich-Grau, 2007 and Anderson and Leal, 2001, for some exceptions).

Second, and perhaps most importantly, we emphasize the potential for entrepreneurial action to establish new institutional incentives for sustainable development, and markets for social and environmental resources. This approach is unique in that few authors describe how entrepreneurs act to transcend collectively sub-optimal incentives structures for sustainable entrepreneurship (see Anderson and Leal, 2001, and Dean and McMullen, 2007, for some exceptions).

Third, our approach is likely the first to incorporate the creation view of entrepreneurship and opportunity into the discussion of sustainable entrepreneurship. Embracing a more subjectivist ontology, the creation view allows for proactive agency on the part of entrepreneurs and expands the conception of sustainable entrepreneurship beyond deterministic approaches, which consider institutional development to be external to the entrepreneurial process. We distinguish between *sustainable entrepreneurship discovery opportunities*, which are present in existing economic structures, and *sustainable entrepreneurship creation opportunities*, which require the development of new economic institutions.

Fourth, through the integration of research from institutional economics, we comprehensively address the specific means by which entrepreneurs overcome institutional barriers to sustainable entrepreneurial action. While some authors have proposed individual solutions to specific market conditions (Ostrom, 1990; Osés-Eraso and Viladrich-Grau, 2007), none have addressed such a broad array of solutions to prisoners’ dilemma problems in this arena. Neither have these been comprehensively addressed in the sole context of entrepreneurship and the pursuit of economic opportunity. We believe that our theoretical analysis provides the basis for understanding how entrepreneurs create sustainable ventures and thereby imply normative recommendations to entrepreneurs, investors, and policy-makers.

We begin our examination with an explanation of the phenomenon of the green prison, which roots entrepreneurial conflict in environmental performance with the concept of the prisoner’s dilemma. We then present the incentives that drive entrepreneurs to escape the green prison and the implications of such actions on the discovery and creation theories of entrepreneurship and more specifically, sustainable entrepreneurship. Following this, we explain how entrepreneurs escape the green prison by transforming a range of institutions, including: industry norms, property rights, and government legislation. In this process, we explicate our arguments with specific examples. Finally, we conclude with a comprehensive description of the limitations and most importantly, the implications that our perspective has for entrepreneurial action in sustainable development.

3. The green prison

Following the game theory literature (von Neumann and Morgenstern, 1947; Luce and Raiffa, 1957) and work in environmental economics (Bimonte, 2008; Carraro and Fragnelli, 2004; McWhinnie, 2009) we suggest that the metaphor of the prisoner’s dilemma can be applied to a range of opportunities for social or ecological improvement (Hackett, 1997; Hardin, 1968; Ostrom, 1990). In this section we describe the prisoner’s dilemma and its general application to sustainable development issues and more specifically, to entrepreneurial action.

3.1. Understanding the prisoner’s dilemma

The prisoner’s dilemma is a multi-player game commonly used to illustrate the effects of conflicting interests between interdependent individuals (von Neumann and Morgenstern, 1947; Luce and Raiffa, 1957). Metaphorically, the prisoner’s dilemma shows how circumstances in which individuals attempting to maximize their own utility do worse than attempts to maximize the benefits of the entire group (Schelling, 1978; von Neumann and Morgenstern, 1947; Nash, 1950). In this game, players choose between two particular strategies (usually defection or cooperation) and the payoffs for their decisions are determined collectively by the strategies of all players. A cooperative strategy implies that a player sacrifices individual gains in favor of collective benefits, while defection implies that individual benefits are the priority.

The typical payoff matrix for the prisoner's dilemma game is illustrated in Fig. 1. In a two-player game, defection when the other player cooperates leads to the highest payoff (4). In contrast, cooperating when the other chooses to defect, results in the lowest outcome (1). The payoffs for mutual cooperation supercede those for mutual defection ($3 > 2$). However, the safest strategy is to defect as it either leads to a payoff of 4 or 2, eliminating the likelihood of receiving a 1. When uncertainty about the opponent's strategy is present, defection can become the dominant strategy in this game. In this case, players will receive a payoff of 2 for defection, rather than a payoff of 3 for mutual cooperation. This illustrates how self-interest seeking can lead to a sub-optimal solution, as cooperation would enhance the utility of both parties, yet it would fail to be the chosen strategy. Therefore, if each individual acts rationally and pursues his or her own interest, both the collective and individual outcome is worse than if they had not (Schelling, 1978).

The pervasiveness of the prisoner's dilemma has also been examined by the evolutionary game theory (EGT) literature (Maynard Smith and Price, 1973; Maynard Smith, 1982). This area of study examines the transformation of strategies in a game across time. It expands the classical game theory agenda by analyzing how individual behaviors evolve as players learn about the strategies of others in a multi-period game (Mailath, 1992). Thus, in the long run, successful strategies (those with higher payoffs relative to the profile of the strategies in the game) are replicated, while others are discarded from the game.

The EGT literature introduced the concept of an evolutionary stable strategy (ESS), as that which exists when a population of strategies cannot be invaded by a player adopting a different strategy (Maynard Smith, 1982). The impossibility of an invasion implies that the frequency to which the native strategy (the current stable pattern of behavior) is being played does not decrease when a new strategy is introduced to the game (Bendor and Swistak, 2001). Following this rationale, the EGT literature has concluded that in a repeated prisoner's dilemma game, a strategy of mutual defection can be evolutionary stable (Axelrod, 1984; Maynard Smith, 1982).

This conclusion has very important implications, as it suggests that a defection strategy can resist invasion from a cooperation strategy and has the ability to eliminate cooperation from a game. From a sustainable development perspective, it implies that in competitive contexts characterized by the prisoner's dilemma, pollution and other environmentally degrading behaviors can be stable and persistent throughout time (Bimonte, 2008; Carraro and Fragnelli, 2004; McWhinnie, 2009). Indeed, the stability of these behaviors explains the apparent limits of entrepreneurial involvement in certain sustainability issues.

3.2. The prisoner's dilemma and sustainable development

The use of the term sustainable development was popularized by the World Commission on Environment and Development (The Brundtland Commission), in its report "Our Common Future," which defined the term as "meeting the needs of the present generation without compromising the ability of future generations to meet their needs" (Brundtland, 1987). The quality and stability of the environment and human society are powerfully correlated, and the term sustainability is broadly applied to address this relationship. The vision of sustainability seeks to achieve long term beneficial interaction between human systems and their ecological support systems, such as the earth's climatic system, oceans, and forests. Thus, the concept of sustainability addresses both social and environmental welfare. While recognizing the critical importance of cultural and social sustainability, we focus more specifically on ecological (or environmental) sustainability. This approach assumes a fundamental link between ecological impacts or improvements and social outcomes, but it is limited by not addressing their link in more detail. In addition, our discussions use the terms environmental entrepreneurship and sustainable entrepreneurship interchangeably.

The dilemma of individual versus collective benefits exists in many individual and group decisions relative to ecological sustainability. Specifically, the non-excludable nature of environmental resources fosters situations in which individuals are

		Player 2 (p2)	
		Cooperate (C)	Defect (D)
Player 1 (p1)	Cooperate	3,3	1,4
	Defect	4,1	2,2

Payoff Matrix: (p1,p2) $4 > 3 > 2 > 1$

Fig. 1. Payoff matrix in a prisoner's dilemma game.

incented to defect by increasing their benefits from environmental resources (such as polluting a waterway) without contributing to their conservation (Hardin, 1968; Ostrom, 1990). One simple example is a manufacturer's decision to add (or not to add) a smokestack scrubber to its facility in order to reduce emissions. Absent regulations which require the manufacturer to do so, and assuming that the scrubber is a costly addition to the company's production function, deciding to spend money on the scrubber would place the producer at a cost disadvantage relative to competitors. In a more apropos example, builders who integrate green features (for example, energy efficiency) into their residences may not be able to capture the benefits provided to either society (in terms of reduced greenhouse gas emissions) or their customers (in terms of saved utility costs) if there is no reward for the behavior. The prisoner's dilemma phenomenon may also explain broad environmental challenges such as global warming (Colman, 2006; Soroos, 1994); whereby the myriad of organizations and individuals who benefit from the emission of greenhouse gases are motivated to continue their emissions in the absence of restraints over air use or economic benefits from cessation of their emissions. Such individualistic behavior, however, could affect global temperatures, thereby imposing significant costs on society. In short, sustainable decisions are often constrained by prisoner's dilemma situations in which defecting behavior may persist regardless of the social benefits of environmental stewardship.

3.3. The phenomenon of the green prison

We apply the metaphor of the prisoner's dilemma to explain the decision of entrepreneurs to implement (or not implement) practices and business models that reduce environmental degradation or enhance the conditions of natural resources. We define cooperation as the act of undertaking a sustainable initiative or business model at a net cost, while defection implies that this practice is not undertaken. To illustrate the structure of payoffs under such circumstances, assume that two players are involved in a repeated prisoner's dilemma game. A cooperation strategy is denoted by C, while defection is represented by the letter D. The payoff to an individual adopting D, given that its opponent is playing C is represented as $P(D,C)$ and vice versa. The payoff of an individual adopting a D strategy, given that its opponent is playing D, is illustrated as $P(D,D)$, and the same pattern applies for cooperation. The magnitude of the initial payoffs is proportional to the typical prisoner's dilemma outcomes, whereby the payoffs to the first player are: $P(D,C) > P(C,C) > P(D,D) > P(C,D)$.

Following the above hierarchy of payoffs, a strategy of defection while others cooperate at a cost leads to the highest benefits thereby providing a competitive advantage for those who defect. In addition, a strategy of mutual cooperation ($P(C,C)$) is more desirable than mutual defection ($P(D,D)$) due to the detrimental collective effects (for example, negative industry-level outcomes) that result from defecting behavior. In a sustainability context, this occurs when mutual defection through environmentally degrading behavior jeopardizes the future of an industry in a variety of ways. First, it could pose a threat of future governmental regulation with significant compliance costs and reduced strategic flexibility; affecting all firms in the industry (Maxwell, 1996; Walley and Whitehead, 1994). Second, environmental degradation could affect the conditions of natural resources that are necessary inputs to the industry's activities (Botkin and Keller, 2003). Third, environmentally unsound practices could impact the image of an industry; generating legitimacy concerns (Christmann and Taylor, 2001; King and Lenox, 2000) and other social liabilities. Following this, the payoffs of mutual cooperation are greater than those of mutual defection so long as the benefits enjoyed from 1) the absence of industry level governmental regulation, 2) the availability of natural resources to support industry operations, and/or 3) positive industry reputation, are greater than the benefits of defection. Therefore, cooperation may be in the best interest of the players in the game as the existence and conditions of their industries can be hampered by defecting behavior.

While collective incentives for environmental cooperation might arise from the desire to improve industry or social conditions, the individual short-term costs of cooperation could drive entrepreneurs away from cooperation. Applying the analogy of the prisoner's dilemma implies that entrepreneurs undertaking a *costly* environmental initiative will receive lower benefits than those that choose to defect. This in turn creates a competitive disparity between defectors and cooperating entities. Thus, even entrepreneurs that understand the benefits of cooperation may be forced into defection in order to prevent competitive loss. This behavior is reflective of the evolutionary stability of defection in prisoner's dilemma-type games (Axelrod, 1984). We refer to this phenomenon as the "green prison": wherein entrepreneurs are compelled into collectively sub-optimal (unsustainable) behavior due to the consequences of competition in a prisoners' dilemma situation. Within the green prison, entrepreneurial activity may often be incapable of efficiently allocating and preserving valuable environmental resources, as bearing their costs may lead to disadvantageous positions (Bator, 1958; Dean and McMullen, 2007; Dorfman, 1993; Pigou, 1932; Tietenberg, 2000).

3.4. Economic institutions in the green prison

There are substantial compatibilities between the study of institutions and prisoner's dilemma situations (North, 1990). Institutions, "the rules of the game" that structure human interaction (North, 1990; North, 1991), define the opportunity set by which economic actors are incentivized and constrained (Bromley, 1989). Within a prisoner's dilemma context, the choice of a strategy is constrained by the institutions that are present. For instance, if the rules of the game allow expelling defecting players, then incentives for cooperation will be higher than in situations where ostracism is not allowed. In this case, the choice for cooperation will be constrained by the presence or absence of the ostracism rule. In short, institutions provide information that is useful to behavior (Langlois, 1992). In a game theoretical sense, they enhance the predictability of the opponent's behavior and thus, assist in the selection of the focal player's strategy (Schotter, 1981; Sugden, 1986).

4. Escaping the green prison

The discussion above makes it clear that 1) prisoner's dilemma conditions may exist in competitive games, 2) the dilemma of individual versus collective benefits exists in many individual and group decisions relative to ecological sustainability, 3) such conditions may be evolutionarily stable and therefore difficult to alter within the boundaries of the game, and 4) economic institutions determine the rules of game and the payoff to decisions with the game. The critical implication of these conclusions is that the green prison may be evolutionarily stable unless the rules of the game—that is, the institutions that drive incentives for defection or cooperation—are altered. We characterize these actions as “the escape”: whereby entrepreneurs proactively devise new institutional arrangements to overcome prisoner's dilemma challenges that prevent the exploitation of sustainable entrepreneurship opportunities. Below, we discuss the motivation and consequences of such initiatives.

4.1. Incentives for escape

Entrepreneurs may be motivated to escape the green prison for a number of reasons, but motivations associated with increased economic return are probably most important in our conceptualization. Motivations based on altruistic concerns for society or the environment may be less effective because institutional change is generally a costly endeavor. Thus, while institutional development may be motivated by altruism and the desire to create public goods, the potential to generate economic returns to players in the game is likely a more influential driver of institutional change and the escape. Furthermore, it is possible to conceive of institutional structures that enhance economic returns of the entirety of players in the competitive game, or those that benefit only an individual entrepreneur or subset of players. In the former case, industry members benefit from decreases in environmental degradation that can threaten the long-term viability of the industry or sector. In addition, institutional development activities can be bolstered by the actions of other players who perceive similar benefits. In the latter case, players may benefit from the achievement of competitive advantage over other members of the sector or industry, but face the challenge of implementing new institutional structures against the interest of such players. In any case, when entrepreneurs escape the green prison, society benefits from enhanced environmental conditions. In this manner, when cooperation is introduced, actors outside of the game enjoy the positive externalities that result from the internal dynamics of the game.

Regardless of the motivation, escaping the green prison requires transforming the rules of the game through the development or alteration of the institutional structures that determine the payoffs associated with a particular strategy. To escape from the green prison, institutions must be developed that transform the magnitude and therefore, the competitiveness associated with the payoffs of the game. These institutions must either reduce the benefits of defection or enhance those of cooperation, such that $P(C,D)$ is higher than $P(D,C)$ and $P(D,D)$ (for the first player). Since cooperation is desirable, the long-term effect of these new institutions may be a strategy of mutual cooperation whereby all players in the game are able to implement a particular sustainable initiative or business model. This effect is triggered by either the recognition of all players of the transformed competitive benefits of cooperation or the obligation to cooperate as dictated by an institutional change (for example, through mandatory rules towards sustainable practices). In this case, the structure of payoffs is best represented by $P(C,C)$, whereby players receive the same reward and competitive parity is achieved.

Reaching this type of equilibrium, however, may be subject to time constraints or may be impossible given certain resource allocations. Specifically, while some players will be able to implement a sustainable practice immediately after the institutional change, others will need to gather the necessary resources to initiate the change. These conditions may grant a temporal competitive advantage to those who can undertake the practice first. In addition, there are circumstances under which the implementation of a sustainable business model or practice requires certain inimitable or non-substitutable resources. In these cases, only those players in possession of these resources will be able to undertake a cooperation strategy and will enjoy a sustainable competitive advantage (with payoffs equivalent to $P(C,D)$; which are transformed to be greater than any defection strategy) (Barney, 1991; Dierickx and Cool, 1989). This competitive value, perhaps combined with industry wide collective benefits and the prospect for appropriating the value of environmental practices, provide incentives for escaping the green prison.

4.2. Escaping the green prison and sustainable entrepreneurship opportunities

Escaping the green prison implies that entrepreneurs possess the agency to recognize obsolete incentive and reward structures and to promote new rules in a “bottom-up” fashion. This perspective is therefore aligned with a creation view of entrepreneurship, which assumes that entrepreneurial opportunities must be created or “instantiated” (Sarason et al., 2006) by the agency of the entrepreneur (Aldrich and Kenworthy, 1999; Gartner, 1985). Perhaps most importantly, this perspective requires an expansion of the prevailing characterization of the entrepreneur: from an individual that discovers opportunities in the extant economic conditions of markets (Kirzner, 1973), to one that proactively affects the underlying institutions that drive economic incentives. Using this characterization allows us to ultimately distinguish between two distinct types of sustainable entrepreneurship opportunities: those that are discovered within existing institutional structures and those in which the entrepreneur must first create the institutions that facilitate its exploitation. To understand this, we first describe the premises of entrepreneurship theory regarding the nature of entrepreneurial opportunities.

4.2.1. Discovery and creation views of entrepreneurial opportunities

Research on the sources of opportunity may be usefully categorized into discovery and creation views (Alvarez and Barney, 2007). The discovery view argues that opportunities are present within the extant economic system and discovered and exploited by alert entrepreneurs who benefit from the widespread ignorance of other market participants regarding those opportunities (Dean and Meyer, 1996; Hayek, 1945; Kirzner, 1973, 1979; Shane and Venkataraman, 2000). It suggests that the presence of objective opportunities creates incentive for entrepreneurial action and the generation of entrepreneurial profit or rent (Rumelt, 1987). Discovery perspectives adopt a largely objectivist or positivist ontology; wherein opportunities are created by external forces over which the entrepreneur has no influence (Shane and Venkataraman, 2000; Alvarez and Barney, 2007; Sarason et al., 2006, 2008). The discovery entrepreneur lives in a deterministic world in which his/her role is to find opportunities in an extant, and external, economic system.

In contrast, the creation view of entrepreneurship and entrepreneurial opportunity argues that opportunities do not exist until created by the actions and perceptions of the entrepreneur (Aldrich and Kenworthy, 1999; Alvarez and Barney, 2007; Chiles et al., 2007; Gartner, 1985; Sarason et al., 2006, 2008; Sarasvathy, et al., 2003). Rather than being discovered, opportunities are “effectuated” (Sarasvathy, 2001) or “instantiated” (Sarason et al., 2006) through a process of recursive interaction with economic structures in which the entrepreneur exhibits the agency to influence those structures. Thus, opportunities are not necessarily assumed to exist as objective phenomenon. Nor are they argued to exist as singular phenomenon, which an entrepreneur must mirror in order to be successful (Alvarez and Barney, 2007; Sarason et al., 2006). As such, creation theories generally reject objectivist and positivist ontologies, and adopt more subjective or reflexive ontological perspectives (Alvarez and Barney, 2007; Sarason et al., 2006, 2008). These ontologies appear to range from highly constructivist (Gartner, 1985; Sarason et al., 2006), to more realist (Alvarez and Barney, 2007). Regardless, creation theories of entrepreneurship clearly discard determinism in entrepreneurial action, and embrace entrepreneurial agency and the endogenous creation of opportunities.

4.2.2. Types of sustainable entrepreneurship opportunities

Consistent with the two views of entrepreneurial opportunities, we contend that sustainable entrepreneurship opportunities, and by extension, sustainable entrepreneurship, can be classified into two distinctive types. The first type of opportunity for sustainable entrepreneurship includes those available under extant economic incentive and reward systems. In other words, current economic structures are sufficient to make the exploitation of such opportunities profitable, because the entrepreneur is able to appropriate a sufficient portion of the social value they create. We refer to such opportunities as *sustainable entrepreneurship discovery opportunities*. Consistent with an Austrian view of entrepreneurship, such opportunities are created exogenously (due to technological developments, resource price increases, changes in consumer preferences or other changes), and await discovery by the alert entrepreneur. As such, traditional entrepreneurship theory can be readily applied to explain their existence and the processes necessary for discovery, evaluation, and exploitation.

The second type of opportunity for sustainable entrepreneurship includes those that require the alteration or creation of economic incentive and reward systems. Such opportunities allow entrepreneurs to proactively free themselves from prisoner's dilemma situations by creating new institutional structures. Consistent with the growing focus on creation perspectives in entrepreneurship theory (Aldrich and Kenworthy, 1999; Alvarez and Barney, 2007; Gartner, 1985; Sarason et al., 2006, 2008; Sarasvathy, 2001), we refer to them as *sustainable entrepreneurship creation opportunities*.

Creation opportunities for sustainable entrepreneurship are particularly significant for a number of reasons. First, and perhaps most importantly, they are practically and theoretically more intractable because they require much more than just entrepreneurial alertness to exploit. In the analogy of Alvarez and Barney (2007), they are mountains that must be built before they can be climbed. Second, given the magnitude of incentive problems in our current economic system, they may represent the greatest source of sustainable entrepreneurial opportunity and the greatest potential to create value through more sustainable business models. Finally, sustainable entrepreneurship creation opportunities are theoretically interesting because extant entrepreneurship theory has yet to extensively address how the barriers to the exploitation of these opportunities might be overcome.

Following this logic, we contend that a complete understanding of the sustainable entrepreneur requires embracing both the discovery and creation views of entrepreneurship. In contexts where sustainable actions are rewarded by extant economic systems, the process of discovery entrepreneurship is sufficient to account for the phenomenon. In the green prison, however, a creation approach is necessary to account for the ability of entrepreneurs to alter the economic institutions that drive incentives and sustainable behavior.

This perspective on sustainable entrepreneurship embraces a realist perspective and thereby spans both the “discovery” and “creation” views of entrepreneurship. By recognizing the objective presence of exogenously-created opportunities for sustainable entrepreneurship we remain consistent with the Austrian discovery perspective. By emphasizing the important role entrepreneurs play in altering economic structures (structural agency) to create sustainable opportunities, we transcend the objectivist ontologies of the strict “discovery” view (Kirzner, 1973, 1979; Shane and Venkataraman, 2000). As such, we adopt a critical realist ontology (Bhaskar, 1978, 1986) to allow inclusion of both discovery opportunities, which exist objectively and are created exogenously, and creation opportunities that arise endogenously through the structural agency of entrepreneurs (Aldrich and Kenworthy, 1999; Gartner, 1985; Sarasvathy, et al., 2003; Sarason et al., 2006, 2008). Critical realism, developed to incorporate both the objective and subjective (Sarason et al., 2008), distinguishes between human action and social structures, yet focuses on the agency of human action in influencing social structure (Bhaskar, 1978, 1986; Pozzebon, 2004).

Combining extant Austrian approaches to entrepreneurship theory (Dean and Meyer, 1996; Hayek, 1945; Kirzner, 1973, 1979; Shane and Venkataraman, 2000) with emerging creationist views (Aldrich and Kenworthy, 1999; Alvarez and Barney, 2007; Gartner, 1985; Sarason et al., 2006, 2008; Sarasvathy et al., 2003), we thereby define entrepreneurship as the discovery, creation, evaluation, and exploitation of opportunities to create future goods and services (Chiles et al., 2007). We view sustainable entrepreneurship as the discovery, creation, evaluation, and exploitation of opportunities to create future goods and services that is consistent with sustainable development goals.

In the next sections we explain how entrepreneurs create sustainable development opportunities by devising strategies to escape the green prison.

5. Creating sustainable entrepreneurship opportunities: transforming the institutions of the game

The use of a prisoner's dilemma framework to explain institutional evolution is applicable to a set of institutions including industry norms (Axelrod, 1986), property rights (Olson, 1965; Ostrom, 1990), and government legislation (Axelrod, 1984). These types of institutions have received the most attention in the economic study of endogenous institutional change (Alston et al., 1996; Axelrod, 1984; Axelrod, 1986; Young, 1993). Although through different levels of formalization, all of these institutions represent collective understandings and expectations of behavior that influence the interaction across players in a game. We explore how entrepreneurs escape from the green prison by proactively influencing the implementation of industry norms, property rights, and government legislation. In doing so, we discuss the mechanisms that are typically used by entrepreneurs in each of these categories and some examples that best reflect their implementation. Table 1 summarizes our examples by type of institution.

5.1. Escape through industry norms

The term “norm” refers to a standard of conduct or rule of behavior, whereby departure from the rule is followed by some punishment (Bendor and Swistak, 2001). In the words of Axelrod (1986: 1097), “a norm exists in a given social setting to the extent that individuals usually act in a certain way and are often punished when seen not to be acting in this way.” Hence, sanctioning behavior is essential for the existence of a norm. In addition, norms bring uniformity of behavior, as their introduction forces individuals to conform given the expectation that others will also conform (Durlauf and Blume, 2008; Lewis, 1969).

Situations bounded by the prisoner's dilemma often call for enforcement mechanisms, such as those provided by norms (Schotter, 1981). Norms control the interaction between individuals with conflicting interests and are able to maintain stability in

Table 1
Examples of escape from the green prison by type of institution.

Type	Context/entrepreneurs	Description	Structure/enforcement	References
Norms	Great Barrier Reef Tourism Operators	Developed informal codes of conduct	Internal monitoring, social pressure	Huybers and Bennett (2003)
	Nanotechnology industry participants and researchers	Designing informal codes of conduct	Self-enforced	Krupp and Holliday (2005)
	Coffee Growers, Common Code for the Community Coffee Association (4C)	Implemented thirty social, environmental, and economic principles	Internal membership monitoring and mediating. Loss of 4C Membership	4C (2009a,b,c) and Muradian and Pelupessy (2005).
	Organic Food Producers & Processors	Evolved voluntary standards and certification	Voluntary third-Party certification and labeling	Fromartz (2006) and Hess (2004)
	Green builders & architects, U.S. Green Building Council	Created LEED Green Building Standards and point system	Voluntary third-party certification	Dean and McMullen (2007)
Property rights	Maine Lobster Fishermen	Defined and allocated territorial boundaries for lobster fishing	Self-monitoring and enforcement, social pressure, ostracizing	Acheson (1987) and Anderson and Huggins (2003)
	Common forest resources, Villagers in Japan	Defined rights and rules for common land forest use and harvesting	Rotation of monitoring, citizen's arrests, cash fines or loss of rights	Ostrom (1990)
	Chicago Climate Exchange, Corporations	Defined emission rights, established trading platform & rules	Certification and verification by third-party, loss of membership	CCX (2006) and The Economist (2002)
	Water in the American West, Farmers	Established system of transferable water rights for irrigation	Prior appropriation doctrine, Adjudication of rights in court	Andersen and Hill (2004) and Grand Junction Daily Sentinel (2007)
Legislation	Biofuels industry, Khosla Ventures & associates	Used media outlets and lobbying to promote policy favorable to biofuels	Reduced taxes, enhanced subsidies	Little (2006) and PR Newswire (2006)
	Rechargeable Battery Manufacturers, Portable Rechargeable Battery Association	Decreased regulatory barriers to battery recycling, established recycling labeling and service	Funded by manufacturers, voluntary fee-based participation in labeling program	Fishbein (2009)
	Solar Companies, Solar Energy Industries Association, Non-profits	Created partnerships and lobbied for state and federal policy	Tax credits, subsidies, renewable portfolio standards	SEIA (2007) and Namasté Solar (2007) and The Economist (2009)
	Organic Food Producers & Processors, Organic Trade Association	Developed and lobbied for the U.S. Organic Food Production Act	Government defined and enforced standards, certifications, and labeling	Fromartz (2006), Hess (2004) and Lee (2006)

competitive relations (Sugden, 1986). To enforce cooperative behavior, these institutions are often devised within the boundaries of a group to punish those individuals who defect. This could be executed in different ways. For instance, when examining cases of different community norms aimed at protecting environmental resources, Ostrom (1990) notices a variety of sanctioning practices towards defection, which range from minor penalties to ostracism. Her in-depth analysis suggests that the type of sanctioning used may often depend on the severity of the infraction, such that sanctions are escalated as they threaten the stability of the system (Ostrom, 1990). The success of these norms is dependent, however, on the ability to detect deviation from the norm within an effective time frame (Ostrom, 1990; Voss, 2001). To do so, group members must invest in monitoring efforts to identify an infraction and evaluate its severity and the circumstances under which it is committed (Ostrom, 1990).

In addition to direct sanctioning and monitoring, these rule systems are characterized by the presence of *indirect* sanctions in the form of loss of prestige or reputation; the latter which may jeopardize the participation of defectors in future interactions (Axelrod, 1984, 1986; Ostrom, 1990). In this manner, the perceptions of other players and outside stakeholders serve as controlling mechanisms that support the continuation of self-enforcement in these contexts (Khanna, 2001).

To escape from the green prison, entrepreneurs often devise norms with respect to environmental behavior. Indeed, there are multiple examples where entrepreneurs using a particular environmental resource devise rules to protect and monitor its sustained use (Bennett, 1999; Khanna, 2001; Ostrom, 1990). Huybers and Bennett (2003) describe how small and local tourism firms in tropical north Queensland, Australia have created internal norms of cooperation to protect the environment in their areas of operation. Prior to these informal systems, the Great Barrier Reef was at greater risk of degradation given that incentives were favoring defecting behavior (payoffs for defecting while others cooperate are greater than those for mutual cooperation). In these circumstances, some tourism businesses were taking advantage of the “quality of the reef” by bringing customers closer to certain areas that may be attractive to explore (yet detrimental to the reef). This situation reflected a prisoner's dilemma for the tourism operators since defecting while others cooperate provided the highest payoffs in the form of greater consumer appeal for exploring the reef. In addition, under these conditions mutual cooperation was more desirable than mutual defection given the threats that the entire sector would face should the reef suffer damages that impede future business. Facing the threat of environmental damage and its negative repercussions to commercial activity, local tourism entrepreneurs instituted written and unwritten informal codes of conduct that are widely followed (Huybers and Bennett, 2003). These rules regulate activities such as anchoring or reef walking and go beyond the legal requirements instituted by governmental authorities. Additionally, these systems are characterized by internal monitoring through different mechanisms. One of these entails an information gathering program called “eye on the reef”, under which tourism businesses collect and document data on the quality of the reef (Huybers and Bennett, 2003). Rules are also enforced through social pressures, which are the product of the close encounters and repeated interactions amongst entrepreneurs in the area (Huybers and Bennett, 2003). These norms and monitoring systems ensure that defecting behavior is punished (mostly through loss of reputation and social pressures that may eventually affect commercial activity). In the long term, these rules transform the structure of payoffs such that a strategy of mutual cooperation is more desirable.

A variety of industries have witnessed the intervention of entrepreneurs in promoting self-enforced cooperative norms. Today, entrepreneurial sectors like nanotechnology are beginning to explore the possibility of implementing informal codes of conduct to examine the environmental and health risks associated with their operations (Krupp and Holliday, 2005). The uncertainty inherent in these nascent environments (and the new technologies that they sponsor), create a need for these kinds of arrangements. That is, the introduction of new technologies is often accompanied by a lack of rigorous information about their environmental and health effects (Colborn et al., 1997). This is evident, for example, in the introduction of chlorofluorocarbons as refrigerants, which were subsequently found to be responsible for the depletion of the ozone layer (Krupp and Holliday, 2005). This type of uncertainty can motivate entrepreneurs to take the necessary precautions to avoid environmental and social damages that may be detrimental to the survival and well-being of their industries.

The coffee growing industry has also experienced the involvement of entrepreneurial firms in devising norms of cooperation (Muradian and Pelupessy, 2005). Coffee growers created opportunities by establishing rules that sought to improve the environmental performance of the group. Prior to these rules, defecting behavior in the form of usage of pesticides, fertilizers, and full sun environments to grow coffee was predominant given that these techniques increase the short-term productivity of coffee farms (thereby enhancing the payoffs of those who undertake them). These practices, however, have been linked to forest loss and environmental degradation (Perfecto et al., 1996). The threats that such behavior could have on the reputation of the industry and the future productivity of the land and its surrounding ecosystems, prompted coffee farmers together with civil organizations to create the Common Code for the Coffee Community Association (4C): a self-regulating initiative that establishes codes of conduct with respect to social and environmental behavior and an internal governance structure to monitor and mediate the behavior of its members (4C, 2009a; Muradian and Pelupessy, 2005).

Members of 4C are encouraged to comply with a set of thirty social, environmental, and economic principles. The environmental dimension of the code includes areas such as biodiversity (conservation of wildlife and flora), agrochemicals (minimize the use of pesticides), soil fertility (minimize fertilizer use), water conservation, and energy use (including energy conservation and use of renewable energy) (4C, 2009b). Based on a system that assigns different levels of compliance, members are expected to continuously improve their practices to obey stricter guidelines (4C, 2009b). They also receive guidance and information on best practices from informational forums sponsored by the Association (4C, 2009b).

The 4C Association protects the image of the coffee growing industry while imposing the cost on the group rather than on an individual firm. This ensures that, everything else constant, all members receive similar payoffs and can therefore achieve competitive parity. This effect incents cooperation as it reduces the competitive inequalities between members. In addition, the 4C

Association enforces cooperation by ostracizing defectors: firms that fail to comply with the codes of conduct are excluded from further membership (4C, 2009c). These decisions are governed by a Mediation Board—composed of 12 members with a three-year tenure—which settles disputes between members and investigates non-compliance claims (4C, 2009c).

Entrepreneurs may be forced to rely on a sanctioned third-party to devise and enforce industry norms. Specifically, the expansion of their markets away from local boundaries may change the nature of their competition; effectively increasing the number of players involved. This rise in group size creates unfavorable conditions for the establishment and enforcement of internally agreed upon rules (Olson, 1965; Taylor, 1987). In such cases, deviation from the norm is difficult to detect, given the substantial costs incurred in gathering information about the behavior of other players. To resolve these challenges and to create opportunities, entrepreneurs may promote cooperation through collective compliance with third-party norms. The introduction of a centralized authority ensures that there are symmetrical requirements for norm compliance, such that competitive disparity is minimized. Assurance from a third party also reduces uncertainty regarding the future behavior of players.

The evolution of U.S. organic standards is of most interest in assessing the active participation of entrepreneurs in the establishment of third-party sanctioned norms. These standards began as informal agreements to eliminate defecting behavior regarding the use of fertilizers and pesticides in farming operations. The latter increase the productivity of farms, thereby providing attractive payoffs (Fromartz, 2006). To overcome this prisoner's dilemma, farmers began exploring and adopting practices that were better aligned with environmental sustainability. This cooperative behavior, however, was not always rewarded by the market; and farmers and other interested parties began to recognize and promote the need for certification schemes that would reward cooperative behavior (Fromartz, 2006). Indeed, as the popularity of organic farming practices grew, voluntary third party standards were created. For example, the California Certified Organic Farmers, the Oregon and Washington Tilth, the Farm Verified Organic and the Northeast Organic Farming Association had certification programs in place (Fromartz, 2006; Hess, 2004). These institutions provided information to consumers about the behavior of farmers, allowing sustainable practices to potentially gain a premium in the market. When applying the logic of game theory to the organic movement, it becomes apparent that as the number of players (for example, farmers, processors, retailers) grew, institutions in the form of third-party standards were established to reward cooperation and allow the creation of sustainable farming opportunities. In this manner, the evolution of organic food standards demonstrates how entrepreneurs in emerging sectors detect the inefficiencies of their institutional environments, and motivated by competitive reasons, seek ways to transform them. In doing so, they are able to provide a positive environmental outcome while maintaining a desirable competitive position, and effectively, escape the green prison.

5.2. Escape through property rights

Property rights define and delimit the range of privileges, duties, and obligations of individuals with respect to an asset (Libecap, 1989). They “consist of the set of formal and informal rights to use and transfer resources” (Alston and Mueller, 2005: 573). A full set of private rights includes the right to use an asset, exclude others from the use of that asset, derive income from an asset, sell an asset, and bequeath the asset to someone of choice (Alston and Mueller, 2005: 573). When private rights exist and are by definition assigned to individuals, incentives exist to maximize the value of resources, since individuals can accrue direct benefits from them (Barzel, 1997; Eggertson, 1990). In contrast, the lack of private rights creates uncertainty regarding the appropriability of resources (and their respective value) and often encourages self-interest behavior over collectively optimal solutions.

Entrepreneurs develop self-enforced property rights to protect a resource from defecting behavior and exploit creation opportunities. This is illustrated in the distribution of rights that takes place in the Maine lobster fisheries (Acheson, 1987; Johnson and Libecap, 1982). Fisheries are subject to the rising threats of overfishing, which may jeopardize the long-term viability and existence of commercial activity in these sectors. Therefore, there is a greater incentive for long-term mutual cooperation in the form of resource conservation as opposed to mutual defection through collective overfishing. Despite this, the short-term incentives to over fish are appealing, given the potential for greater profits. This resembles a prisoner's dilemma situation since the payoffs for defecting when others cooperate are highest. In response to this, the Maine lobstermen have introduced rights that define the territorial boundaries for fishing. Acceptance by other fishermen is necessary to become a member of the “Harbor gang”, and thus be granted stock access to fish in the area. Areas closer to the harbor are very well defined, and the fishermen monitor who enters the fishery and police the territories to ensure that property assignments are maintained (Anderson and Huggins, 2003). The success of these property systems is reflected in their ability to conserve lobster in the area. By controlling access to the harbor, the fishermen ensure that sufficient lobster volumes are maintained for future harvesting. The ability to promote this type of cooperative behavior enables the fishermen to escape the green prison by facilitating the continuation of sustainable fishing practices that would otherwise be penalized through competitive disadvantage.

Ostrom (1990) presented another popular example of the creation of property rights with the objective of deriving economic benefit. Her account of property rights in Japan suggests that since the 1600s and to this date, villagers in Japan have assigned rights to common land, while collectively enforcing their allocation (Ostrom, 1990). These lands produce a variety of valuable forest products including timber, plants for fertilizers, firewood, and charcoal (Ostrom, 1990); thereby providing opportunities for commercialization. Rights of access to the land are allocated to different households and rules are established regarding harvesting quotas and conditions. Each village devises their own monitoring system. In some villages, males rotate to monitor the land and enforce its appropriate use (Ostrom, 1990). In others, anyone is authorized to report violations and conduct “citizen's arrests” (Ostrom, 1990). Different types of sanctions exist to enforce the allocation of property rights. In the case of an infraction, a village

detective can demand payment in the form of cash or sake. Violators are also deprived of their harvest and other privileges (Ostrom, 1990). Together, these institutions allowed farmers and others with commercial interests to prevent defecting behavior in the form of land overuse and exploitation, which is endemic of common property circumstances (Hardin, 1968). The situation was transformed to punish defection; such that defecting while others cooperate yielded lower payoffs (given the penalties for doing so) than mutual cooperation.

Entrepreneurs may introduce a third party to allocate and enforce property rights. Since monitoring access and the use of property can be costly, a centralized authority may be called for. This in turn reduces the enforcement costs incurred by each individual player and creates an incentive for private ownership. For instance, rising concerns about global warming and, perhaps, the threat of potential punitive governmental intervention, motivated a number of firms in the U.S. to support the Chicago Climate Exchange: an initiative that assigns property rights to greenhouse gas emissions. Under this agreement, firms have the option to use their rights, and/or buy and sell them within their internal market (Chicago Climate Exchange, 2006; The Economist, 2002). The distribution of rights and the exchange are designed and governed by the Chicago Climate Exchange (that is, a centralized authority). This assignment of property rights, which in turns enables the formation of a market, creates the appropriate incentives for cooperation. Firms now seek to maximize the value of their emissions rights, which is directly tied to their environmental performance. This and other examples illustrate the innovative ability of entrepreneurs to establish self-enforced and third party assigned property rights that enable them to create sustainable opportunities.

5.3. Escape through government legislation

So far, our discussion of institutions has focused on those that are voluntarily adopted. However, cooperative institutions may also evolve into mandatory rules that are codified and enforced by governmental bodies. Indeed, government intervention is often the solution to cooperative conflicts of the prisoner's dilemma kind (Axelrod, 1984). The law ensures that when individuals are not incented to cooperate, they will be required to do what is collectively beneficial. Thus, a main function of positive law is to mitigate the effects of the prisoner's dilemma by enhancing the payoffs for cooperation and/or punishing defection (Axelrod, 1984).

Entrepreneurs may be prompted to request the intervention of governmental authorities to instill cooperative behavior and enable the exploitation of sustainable entrepreneurship creation opportunities. This tendency towards formalization is particularly observed as the size of an industry increases and the boundaries of its markets expand; as well as in the presence of conflictive norms that create uncertainty about competitive behavior.

The desire to influence government sponsored rules to create sustainable entrepreneurship opportunities is evident in the strategies undertaken by Khosla Ventures—a California based company that offers assistance, strategic advice and capital to entrepreneurs launching sustainable businesses. Having a series of sustainable energy and biofuel companies in its portfolio, Khosla Ventures is publicly known to be an advocate of ethanol in the U.S. (Little, 2006; PR Newswire, 2006). The company often promotes the elimination of oil subsidies and the inclusion of carbon taxes that would improve the competitiveness of ethanol producers (Little, 2006; Khosla, 2006). The intensity of the efforts sponsored by the company's founder, Vinod Khosla, has been recognized by a variety of media companies. He has been referred to as “the evangelist of biofuels” (Little, 2006) and was proclaimed the number one venture capitalist by Forbes and Fortune Magazine, who labeled him as one of the most influential ethanol advocates in the U.S. (PR Newswire, 2006).

Khosla Ventures has undertaken a variety of strategies to promote changes in the government incentives that drive ethanol and fossil fuels production. The company uses different media channels, such as magazines, the Internet and interviews in broadcast radio, to deliver its message. For example, in 2007 Vinod Khosla co-authored an article entitled “Change the Rules, Change the Future”, where the authors suggest that environmental degradation is partly a consequence of government incentives that grant research subsidies and tax breaks to oil and gas companies who contribute to greenhouse gas emissions and other sources of pollution (Wirth et al., 2007). The company also uses their corporate website to share information about the benefits of certain environmental practices, policy recommendations for these practices, and the technological pathway that the company expects these practices will take (Khosla, 2006). In addition, Khosla Ventures engages in lobbying efforts to attempt to influence policymakers directly. Indeed, in 2008 the company hired a lobbyist and incurred \$70,000 in related expenses (The Center for Public Integrity, 2009).

In 2007 Range Fuels, a cellulosic ethanol producer funded by Khosla Ventures, announced it would build an ethanol plant in Georgia. Two weeks prior to the announcement, the governor of Georgia introduced legislation to exempt businesses from the payment of sales taxes related to the procurement of materials and equipment used in the construction of biofuel facilities (Governor Sonny Perdue, Office of the Governor, 2007). This type of legislation eases the competitive challenges that Range Fuels faces in the midst of lower-cost production of other fuels that are potentially more harmful to the environment.

In sum, it appears that Khosla Ventures is attempting to escape a competitive situation reflective of the green prison. In the area of fuel production, most competition comes from oil companies whose practices may be contributing to environmental challenges such as climate change. To overcome this pattern of defection, Khosla Ventures is promoting the usefulness of new rules—such as cutting subsidies for oil companies—that decrease the payoffs of defecting behavior; thereby allowing cooperation to come into the game.

In an effort to enhance the position of their industry and product, rechargeable battery manufacturers motivated legislation to increase the recycling rate of rechargeable nickel cadmium (NiCd) batteries in the U.S. (Fishbein, 2009). Prior to 1995, the handling and disposal of rechargeable batteries was covered under the Resource Conservation and Recovery Act (RCRA) of 1976, which provided for strict and costly handling and disposal of batteries. Consumers were exempt from the provisions of the act, but an

industry attempt to recycle the batteries would have been cost prohibitive because RCRA rules would have applied. Industry players were constrained from action by the costs of the RCRA compliance and faced the dilemma of the green prison.

Likely recognizing the reputational and competitive risks of continued inaction, industry leaders diverged from their traditional trade associations and organized the Portable Rechargeable Battery Association (PRBA) to promote federal legislation that reduced the costs of rechargeable battery recycling (by eliminating regulatory barriers under RCRA). PRBA then formed the non-profit Rechargeable Battery Recycling Corporation (RBRC) to label, collect, and recycle the batteries (now known as the Call2Recycle program). The RBRC is funded by the major rechargeable battery manufacturers based on the weight of batteries sold, and continues to be the primary rechargeable battery recycling organization in the U.S. The RBRC has helped promote new technologies and ventures by adding new battery technologies to its recycling program. The most recent addition was nickel zinc rechargeable batteries, which are marketed by start-up venture, Powergenix ([Rechargeable Battery Recycling Corporation, 2008](#)). Although there remains some criticism of the RBRC and the rate of rechargeable battery recycling in the U.S. ([Inform, 2005](#)), the PRBA enhanced the competitive positions of its members by reducing regulatory barriers to rechargeable battery recycling.

The U.S. solar energy industry has recently witnessed the activism of entrepreneurs in seeking government intervention ([The Economist, 2009](#)). Entrepreneurs recognize that while solar technologies bring an environmental advantage to energy generation when compared to fossil fuel based technologies ([Heavner et al., 2003](#)), such advantage is often penalized by higher costs (thereby exemplifying the paradox of the green prison). In attempting to improve the payoffs of cooperation, entrepreneurs in the solar industry have been actively involved in lobbying governmental authorities for the establishment of policy that offers an advantage to these strategies (by means of tax credits, subsidies, solar energy production requirements, and other incentives) ([Solar Energy Industries Association, 2007](#); [The Economist, 2009](#)).

Solar energy ventures often use the industry's leading trade association—the Solar Energy Industries Association (SEIA)—as a conduit for voicing the needs of the industry. This organization has served as a powerful advocate for the interests of the industry by actively lobbying legislators and other authorities ([Solar Energy Industries Association, 2007](#)). At a more local level, new ventures also partner with nonprofit organizations in attempts to influence energy legislation. Such is the case of Namasté Solar—a small company dedicated to designing and installing solar electric systems throughout Colorado—which has taken a leadership position in the local chapter of SEIA as well as public sponsorship of environmental organizations such as Western Resources Advocates ([Namasté Solar, 2007](#)). The latter was fundamental in the passage of Amendment 37 in Colorado, which mandates power generators to obtain 4% of the total electricity of the state from solar energy sources ([Namasté Solar, 2007](#)). Indeed, Namasté Solar uses such legislative milestones as evidence of their commitment to the success of the industry ([Namasté Solar, 2007](#)). This in turn illustrates how new ventures can be involved in the establishment of legislation that improves the payoffs of cooperation relative to defection, which allow them to protect or enhance their competitive position.

Returning to the example of our previous section, the organic food standards also exemplify how government legislation, motivated by entrepreneurial action, can help further resolve prisoner's dilemma problems. As discussed earlier, a variety of third-party certification regimes were founded concurrently across the United States. These groups, however, were unable to agree on the requirements for certification. These inconsistencies created a prisoner's dilemma type of problem since the lack of agreement for organic standards prompted some farmers to undertake less stringent sustainability practices (at a lower cost) while still marketing their crops as “organic”. Therefore, the payoffs for defecting while others cooperate were highest in the short term. In addition, mutual cooperation was more desirable than mutual defection in the long-term so as to avoid a loss of reputation for “organic food”, which would have impacted all farmers making these claims. Despite this, conflicting perspectives on standardization co-existed for years and attempts towards unification failed to get traction ([Fromartz, 2006](#)). At this stage, the internally enforced norms of the industry were failing to accomplish their objectives. The variability of the standards prompted entrepreneurial firms (farmers, manufacturers of organic food) to lobby for a government-enforced program that would impose symmetrical effects on all parties. As a response to this movement, the Organic Food and Production Act was established in 1990 to regulate the production of organic foods ([Fromartz, 2006](#); [National Organic Program, 2006](#)). This in turn led to the implementation of the “USDA Organic” certification scheme in 2002, which is enforced by federal law.

The need to formalize institutions through government intervention is often accompanied by the need to bring the competitive debate into the public eye. As is evident in our examples, entrepreneurs—in an effort to gain public support—undertake or sponsor different forms of activism. Like Khosla Ventures, they may sponsor campaigns to spread information about the benefits of their practices (or those of the entrepreneurs that they fund) as well as highlight the shortcomings of their competitors. They may also use different media channels and partner with other interested parties to create greater exposure to their practices and values. Furthermore, common in all of our examples is the practice of lobbying governmental authorities. Given that the resources of entrepreneurial firms are commonly limited; these firms often rely on trade associations for lobbying and other political activities ([Astley and Fombrum, 1983](#)). For example, the Organic Trade Association (OTA)—which represents organic food businesses across the supply chain and has over 60% of small business members ([OTA, 2009](#))—was very influential in the passage and amendments for the Organic Food Production Act ([Food Chemical News, 2006](#); [Fromartz, 2006](#)). As described in our examples, SEIA has been playing a similar role in the solar energy sector. These organizations help entrepreneurs to pool resources together and collectively influence governmental bodies.

6. Discussion

The non-excludable and other idiosyncratic characteristics of environmental goods often create a divergence between collective and individual interests, which is manifested in suboptimal collective outcomes ([Tietenberg, 2000](#)). This situation—

which we label as the green prison—resembles a prisoner's dilemma in which entrepreneurs are incented to pursue unsustainable practices. Findings from the game theory literature suggest that such behavior is evolutionarily stable and difficult to displace (Axelrod, 1984; Maynard Smith, 1982). We find, however, that entrepreneurs are able to overcome such dilemmas by influencing the establishment of institutions that enhance the payoffs of cooperation with respect to environmental initiatives.

Our quest for a more comprehensive theory of sustainable entrepreneurship has led us to answer some of the critical challenges in the area. In distinguishing sustainable entrepreneurship from the broader field of entrepreneurship, we suggest that one of the major differences rests in the public and non-exclusive character of environmental resources. These characteristics are conducive to prisoner's dilemma situations, wherein incentives to defect and engage in environmentally degrading activities are often stronger than those for collective cooperation. Under such circumstances, the absence of appropriate incentives towards sustainable behavior constrains entrepreneurial activity. We suggest that a solution to such predicaments lies in the entrepreneurial alteration and/or establishment of institutional arrangements that provide the necessary rewards for desirable environmental behaviors. Indeed, the examples presented in this paper demonstrate that many entrepreneurs choose to follow this approach by arranging different norms, property rights and legislation in an effort to enhance the payoffs to environmental initiatives. Following this, sustainable entrepreneurship takes the character of a structural form of entrepreneurship, which must not only overcome market conditions, but also the institutional barriers that preclude private economic benefits. This implies that sustainable development opportunities are not only discovered by entrepreneurs who equilibrate the conditions of existing markets (Kirzner, 1973). They must also be created by entrepreneurs who actively develop the institutions that support the allocation of environmental resources and practices.

6.1. Limitations

While examples of entrepreneurs driving institutional change to create environmental opportunities abound, this sustainable entrepreneurship approach is not without limitations. These limitations commonly arise from the costs of establishing new institutions, the characteristics of the industry group in which entrepreneurs operate, and the presence of opposing forces with divergent interests. First, when the costs of institutional change outweigh its benefits, entrepreneurs will likely continue operating under the status quo. These costs arise in the form of resources and/or time that must be allocated into the creation and monitoring of agreements with other firms or authorities (Olson, 1965). The inability to recover such investments may place entrepreneurs at a competitive disadvantage, thereby discouraging the pursuit of opportunities. Thus, while some entrepreneurs are able to overcome the financial and competitive barriers to sustainable entrepreneurship creation opportunities, others will not. The evidence presented in this paper suggests that the potential for profit and the collective benefits of an industry serve as an incentive for many entrepreneurs to exploit sustainable entrepreneurship creation opportunities. However, a portion of these opportunities will remain unexploited until it becomes economically desirable to do so (North and Thomas, 1970).

Second, as the size of the industry group in which entrepreneurs operate increases, entrepreneurs face greater challenges in monitoring and enforcing the behavior of competitors (Olson, 1965; Taylor, 1987). This is also common in groups that are geographically distant and unable to physically scrutinize the actions of others (Hardin, 1991). Under these conditions, the strategies that entrepreneurs employ to escape the green prison are likely limited to the introduction of third-parties into the game; so as to secure enforcement of the agreed upon rules. The introduction of a centralized authority, however, often arrives at a cost that must be borne by the players. For example, farmers must pay for USDA organic certification, which depends upon the annual sales of their farms and the certifying agency of choice (Ferguson, 2004). To assist with such costs, the U.S. Department of Agriculture introduced a fund in 2004 that “defrays the cost of organic certification” in 15 states (USDA, 2004). Even though such assistance is partially in place for organic foods, it may not be available in other sectors; forcing entrepreneurs to bear full costs.

Finally, entrepreneurial action towards sustainable creation opportunities may be limited by the opposition of other interested parties. In such circumstances, entrepreneurs may be subject to the political influence of powerful actors that may impair their ability to promote new institutions. For instance, incumbents in competing firms may be threatened by the actions of entrepreneurs and respond by directly manipulating industry rules to favor their interests (Oliver, 1991). In doing so, incumbents may actively support political campaigns to receive legislative support. This behavior has been observed in the electric power industry where established electric utilities have historically opposed a national renewable portfolio standard (RPS) (which as proposed in 2007 would mandate utilities to generate 15% of their power from renewable energy sources by the year 2020) (Cusick, 2007). The utilities argued that such legislation would increase electricity prices and cripple the financial stability of many power companies, as their inability to meet the requirements would force them to buy energy from higher cost sources (Parker, 2007; Cusick, 2007). Legislation to establish a national RPS has been considered by the U.S. Congress since 1997, and in 2007 the U.S. House of Representatives voted to include RPS in an energy bill (AWEA, 2009a,b). Nonetheless, the 2007 senate energy bill did not include the provisions and a national renewable portfolio standard has yet to be passed in the U.S. Opposition from electric utilities may have slowed the progress of a national RPS or other energy initiatives (Snyder, 2007) and undermined the position of entrepreneurs in renewable energy sectors who forcefully support these incentives.

6.2. Implications

Our analysis suggests that there are some important implications for entrepreneurs facing the green prison. Of particular relevance is the manner in which they can escape from such situations. Our examples (see Table 1 for a summary) suggest that collectively approved rules of conduct, certification schemes, the assignment of property rights, and the promotion of legislation,

are different conduits through which escape from the green prison is achieved. Common across all of these strategies is the concept of collective action, which is often necessary in implementing new institutional arrangements. Collective action enables entrepreneurs to pool resources together towards institutional change, so as to reduce the costs incurred by individual entrepreneurs (Aldrich and Fiol, 1994). This is particularly important as entrepreneurial firms often have limited resources that prevent them from individually participating in institutional initiatives (Low and Abrahamson, 1997). In addition, collective organization also reduces the likelihood of free riding from competitors who do not participate in institutional efforts (Olson, 1965). Given these benefits, trade associations may serve as important channels through which entrepreneurs can exploit opportunities for sustainable entrepreneurship. By gathering multiple forces, these groups increase the power of entrepreneurs to bring forth new institutional forms, while reducing the risk of such participation. For example, the National Biodiesel Board has become the leading industry association for the biodiesel sector representing a variety of small businesses (feedstock processors and biodiesel suppliers, amongst others) and proclaims the importance of government incentives in driving the growth of this sector (National Biodiesel Board, 2006).

Entrepreneurs can also take advantage of inter- or intra-industry alliances to attempt to transform the rules of the game and create sustainable development opportunities (Aldrich and Fiol, 1994). By establishing relationships with powerful and reputable actors, entrepreneurs are able to enhance their credibility and overcome some of the challenges associated with escaping the green prison. Specifically, by having the endorsement of reputable and financially stable organizations, entrepreneurs are better able to convince other players (or centralized authorities) of the value of different rules and to safeguard the agreements made by a group of players. The former can be observed, for example, in the wind energy industry where the American Wind Energy Association (AWEA)—which began primarily with a membership base of small and young wind energy firms—is bringing powerful and established parties from other sectors to play important leadership roles. AWEA has members on its Board of Directors from large electric utilities like Xcel Energy and other well established companies such as GE Energy (AWEA, 2009a,b). Through some of this support, AWEA has been a very active voice in favor of wind energy and frequently testifies before state and federal agencies (AWEA, 2009b).

Furthermore, entrepreneurs may go beyond industry partnerships and form relationships with environmental, economic development or other civil organizations. These partnerships bring the momentum of social movements to assist entrepreneurs in devising and enforcing new rules towards sustainable behavior. For instance, the organic and fair trade coffee sectors have witnessed a variety of partnerships between small coffee growers (or federations that represent them) and environmental and civil organizations (Bitzer et al., 2008). Such is the case of the Sustainable Coffee Partnership which links coffee producers from multiple countries with environmental organizations like the Commission for Environmental Cooperation to devise codes of conduct and deliver supporting mechanisms for their implementation (International Institute for Sustainable Development, 2009). This and other partnerships have been very important in aiding entrepreneurs across the globe to devise and enforce new industry norms that allow them to create sustainable development opportunities.

An important attribute of sustainable entrepreneurship creation opportunities lies in their ability to pave the way for increased entrepreneurial activity. The efforts of entrepreneurs to implement new institutional arrangements are often followed by a host of entrepreneurs that wish to take advantage of such structure (Schumpeter, 1942). This is evident, for example, in the burgeoning number of organically certified farms and producers that followed the passage of organic standards (Lee, 2006). In this case, certification—which was promoted by entrepreneurs in an effort to escape from competitive dilemmas—opened the possibility of a new market for sustainable agriculture practices. Thus, following the *development of new industry institutions*, new opportunities for sustainable agriculture became available in the extant economic system and were *discovered* by other alert entrepreneurs, who benefited from the market gaps (divergence between supply and demand) present in the new system. What is clear from the example above and from other evidence is that entrepreneurs that create opportunities may also generate positive externalities that open the doors for sustainable entrepreneurship discovery opportunities. These entrepreneurs create the structure of incentives and rewards under which discovery entrepreneurs find opportunities. Hence, the pursuit of creation opportunities is often responsible for the further growth and continuation of sustainable entrepreneurship.

7. Conclusion

Perhaps most importantly, our examination implies that a complete understanding of sustainable entrepreneurship requires consideration of the means by which entrepreneurs transform economic institutions, and thereby escape the green prison that is intrinsic to many natural and environmental resource problems. As such, sustainable entrepreneurship in its most theoretically interesting and empirically meaningful form is characterized by the processes of creation, as opposed to discovery, and the proactive agency of entrepreneurs who transform economic systems to the benefit of both society and themselves. These sustainable development creation entrepreneurs hold norms, property rights, government legislation and the generalized processes of collective action in their entrepreneurial toolkit. The nature of creation opportunities they pursue, the manner in which they do so, and the individual and collective outcomes they generate from their actions are central issues in research on entrepreneurship and sustainable development; as well as in understanding how entrepreneurs can help create a sustainable future.

Acknowledgements

The authors wish to thank Yolanda Sarason, Lowell Busenitz, Dawn DeTienne, Lumina Albert, Gideon Markman, Sharon Matusik, Jeremy Hall and two anonymous reviewers for their insightful comments on earlier versions of this manuscript.

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