

HIDDEN TRADEOFFS IN SUSTAINABILITY INITIATIVES

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ABSTRACT

Many organizations are adopting “green” initiatives to meet public demand, and different types of green strategic initiatives can be categorized using a competing values framework. There is controversy over how to operationalize those strategies, how to measure them, and what standards to set to determine when a product/service can be certifiably “green.” Standards vary widely by the source, product lifecycle stage, and whether indirect effects from the supply chain are assessed. Further, the selective nature of streamlined life-cycle studies often result in the neglect of important environmental impacts. When criteria exclude environmentally destructive direct or indirect effects, accusations of “greenwashing” undermine the drive for sustainability. Consequently standards and regulation seem to be both socially constructed retrospective rationalizations as well as empirically-based science. Implications are discussed.

CONCEPTUALIZING "GREEN"

As society has become increasingly aware of the extent of damage human activity is having on our planet’s environment it has become clear to many that “business as usual” is not compatible with a thriving future for humanity. By the end of the 20th century the consensus in the scientific community was that several alarming global trends are in dire need of remediation including: plummeting biodiversity levels, increasing deforestation, loss of arable farmland, disappearing aquifers, increasing desertification, growing oceanic dead zones, increasing numbers of species becoming endangered and/or extinct and overconsumption of non-renewable resources (Black & Phillips, 2010). Both within and without the business world, the overall effect of this is an increased the pressure for businesses to “go green” and take on sustainability initiatives. Powerful external coalitions are emerging to champion sustainability. Today’s environmental movement is gaining the support of many groups who, in the past, did not show public support for environmental issues including republicans, religious groups, conservatives, and laborers (Price, 2006; Hirsch, 2006). As Hazell (2009, p. 11) explains, “Sudden dramatic and catastrophic events are expected to become increasingly frequent, so the transformation to a sustainable, green-jobs economy may need to be non-linear.” Yet even as organizations have changed their activities they have come under criticism for the supposed mismatch between the magnitude of the problem and the perceived inadequacies of their initiatives.

One point which has proved a stumbling block to these initiatives is that under the currently favored rubric of “sustainability” a large amount of responsibility is required while little guidance is provided on how to achieve their goals (Robbins & Page, 2012). One popular definition of sustainability is “meeting the social and environmental, as well as the economic needs of the present without compromising the ability of future generations to meet their own needs” (World Commission on Environment and Development, 1987). How this general concept can be operationalized remains both confusing and controversial due to its breadth - from industrial to societal to ecological (Sikdar, Glavic & Jain, 2010). This has also resulted in a variety of assessments from a variety of organizations (Klopffer, 2003, Trotta, 2010).

For example, take “green” / sustainable / high performance buildings, defined by the EPA as being designed, built, operated, maintained, renovated, and reused in an “environmentally responsible and resource-efficient” manner. They must feature the efficient use of energy, water, and other resources to reduce environmental impact. In addition, they must reduce a building’s operating costs, heighten aesthetic qualities, and not only protect, but even improve the health and quality of life of their occupants (EPA, 2010; Skidmore, 2011). In terms of North American green building standards, they vary by the criteria they use and the difficulty of the thresholds they set - there is no uniform standard. In contrast, the tendency is for major stakeholders to introduce their own standards rather than improve existing standards in the interests of clarity:

- United States Green Building Council’s (“USGBC”) Leadership in Energy and Environmental Design (“LEED”): third-party certification of sustainable sites, water efficiency, energy and atmosphere, materials and resource, indoor environmental quality, and innovation in design.
- Canada's Green Building Initiative uses the “Green Globes,” a convenient online assessment tool that evaluates seven main categories on a 1000-point scale: energy, indoor environment, site, water, resources, emissions, and project/environmental management.
- American Society of Heating, Refrigerating and Air-Conditioning Engineers released “standard 189.1,” similar to LEED, but with minimum standards for building greenhouse gas emissions.
- State standards, such as "CALGREEN" in California, and local standards in a variety of major cities, are used in conjunction with, or in place of, the above national standards.

Lifecycle Complications

Regardless of the model being used, complexity intensifies when the entire product or service lifecycle is examined. In many green strategic models, clear distinctions across quadrants and along continua often depend on which aspect and phase of sustainability lifecycle is examined. Consequently there are many lifecycle assessments from a variety of organizations, including:

- Environmental lifecycle assessments [(LCA, ISO 14000)] which tend to be product-related and focus on energy, resources and waste.

- Economic lifecycle assessments, also known as life cycle costing (LCC), Full cost accounting (FCA) and total cost Assessment (TCA), which explicitly factor in the impact of raw and intermediate materials in the supply chain.
- Social life cycle assessments (SLCA), the least developed aspect of sustainability, primarily because they are difficult to quantify (Hendrickson et. al., 1998; Klopffer, 2003, Trotta, 2010).

Product lifecycle management (PLM) and assessment (LCA) literatures provide a comprehensive inventory to identify the factors which complicate assessing whether a product or service is truly "green" using both lifecycle and systems theory (Rosselot & Allen, 2000; Trotta, 2010), as adapted in Figure 1:

Inputs	Throughputs	Outputs
Energy Raw Materials Components Services	1. Acquisition	<i>Direct:</i> Products & Services Emissions & Effluent Solid Waste
	2. Manufacturing & Processing	
	3. Distribution & Packaging	<i>Indirect:</i> Consumer Preferences Community & Culture Legal & Political Resource Allocation
	4. Use / Re-Use / Maintenance	
	5. Recycling & Recovery	
	6. Waste Management & Disposal	

FIGURE 1: LIFECYCLE INVENTORY

The comprehensive scope of environmental assessment remains more ideal than real for the foreseeable future, particularly since some metrics for measuring indirect effects have proven problematic. Rosselot and Allen (2000, p. 323) note:

The use of life-cycle studies falls along a spectrum from a complete spatial and temporal assessment of all the inputs and outputs due to the entire life-cycle (which may never be accomplished in practice, both because of a lack of information and because it would require a tremendous amount of effort and expense) to an informal consideration of the environmental stresses that occur over a product or process life-cycle.

Given the resource intensive nature of comprehensive life-cycle assessments, they are rare. Far more common are "streamlined" life-cycle assessments, arguing that only the most important life-cycle stages or type of inputs and outputs causing the most significant environmental issues can be identified for more detailed study. Streamlined life cycle assessment reduces the resource intensive nature of data collection choosing among the following assessment strategies:

- building extensively on previously completed life cycle assessments
- using pre-existing data on energy use
- focusing on toxicity
- omitting certain product components or materials as insignificant
- omitting certain lifecycle stages
- using economic value to assess resource scarcity and ease of manufacturing (Bansal & Hoffman, 2012; Rosselot & Allen, 2000)

THE STRATEGIC ECO-BUFFET

Given this overwhelming complexity there is no consensus on how to best achieve sustainability, how to measure it, and what standards to set to determine when a product or service has retained that status. In one of the most well-known models (Hart and Milstein, 2003), suggested that green strategic initiatives could be categorized by where they fall along two continua, which they term "creative tensions." Some strategic initiatives focus on the internal operations and processes of the organization, while others target the external impact on and green outcomes in the firm's industrial and general environment. These strategies can also be distinguished by their future orientation - the degree to which they focus on current versus future organizational needs and opportunities. Their model is illustrated in Figure 2:

		Tomorrow			
Internal	<i>Clean Technology:</i> Sustainable competencies of the future (Clean tech) [Innovation & Repositioning]	<i>Sustainability Vision:</i> Shared roadmap targeting unmet global needs [Growth Trajectory]		External	
	<i>Pollution Prevention:</i> Minimize waste and emissions from operations to control risk [Cost & Risk Reduction]	<i>Product Stewardship:</i> Integrate stakeholder views into the business process [Reputation & Legitimacy]			
		Today			

FIGURE 2: SUSTAINABLE VALUE FRAMEWORK

In contrast, other researchers have linked green initiatives with various organizational strategies, although they cannot agree on which strategic variables are most pertinent:

- Innovation versus efficiency focus (Williams, Brooks & Page, 2012)
- Product/service versus process innovation (Orsato, 2006)
- Generic sources of competitive advantage (low cost versus differentiation) (Orsato, 2006)
- Degree eco-friendly products/processes differentiate the firm (Ginsberg & Bloom, 2004)
- Relative importance of the market segments involved (Ginsberg & Bloom, 2004)
- Degree of customer-benefit (productivity, costs, etc.) (Siemens 2010; Trotta, 2010)
- Degree of positive environmental impact (Siemens 2010; Trotta, 2010)

Differences in these models will be explored using a “competing values” approach, which captures the inherent paradox involved in organizational effectiveness issues such as sustainability (Quinn & Rohrbaugh, 1983; Quinn, 1991). The classic competing values framework focuses on private sector organizations and the major schools of academic thought that have evolved to study them, as summarized in Figure 3:

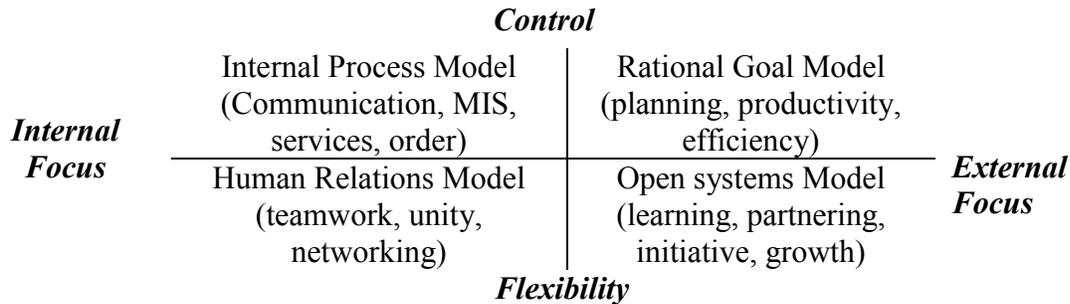


FIGURE 3: COMPETING VALUES FRAMEWORK

While the terminology and specific sustainability strategies may vary from model to model, underlying general strategic foci are somewhat congruent, and can be categorized using a competing values framework, illustrated in Figure 4:

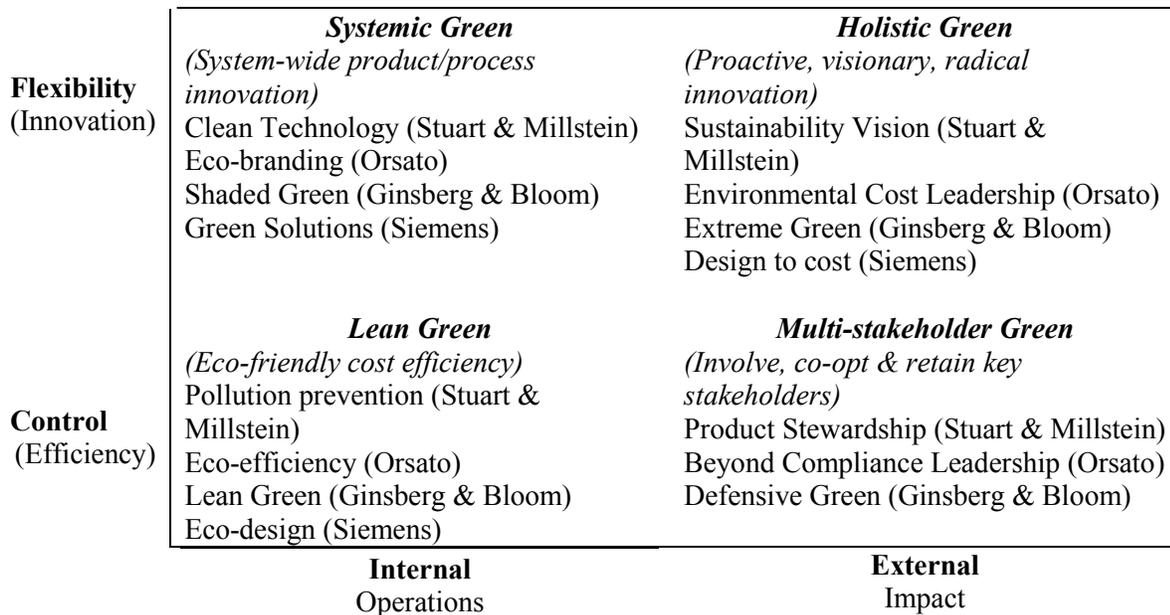


FIGURE 4: GREEN INITIATIVES

Multi-stakeholder Green

Green strategies in this quadrant are often characterized by a defensive and/or public relations focus. Due to a crisis, political/legal trends, or competitive threats, these green efforts reflect leveraging green features of the product/ service line more than any fundamental commitment to environmental sustainability. By reaching out to involve a variety of stakeholders, and listening to their feedback, executives hope to placate eco-concerns and either build goodwill or at least minimize future criticism. Large corporations with strong political networks and allies in local, state and federal government can even receive incentives to adopt green alternatives. These strategies are often reactive or precautionary moves to either mitigate damage or protect organizational legitimacy in the minds of consumer segments executives feel they cannot afford to lose (Ginsberg, J. & Bloom, 2004; Hart & Milstein, 2003). Organizations in this quadrant often publicize their efforts to build a greener reputation and consumer goodwill, and may minimize those efforts when they no longer command public attention (Orsato, 2006).

Some of the most popular strategic initiatives in this quadrant involve remediation. Particularly in pollution intensive industries, managers view and deal with issues of sustainability using a series of ecologically friendly enhancements. Initiatives of this type deal with products and services which continue business as usual, but in a cleaner and more efficient manner. They incorporate tools for cleaning up or containing the messes created more effectively. They retain the same type of inputs and outputs which cause the eco-problems, but try to mitigate the pollutants generated.

One tool for cleaning up "the mess" is the development of super microbes to either digest the toxins, or otherwise neutralize them as stable precipitates (EPA, 2010). This type of tool proved far more effective at removing oil from the Gulf of Mexico's water in the 2010 BP oil spill cleanup than any other alternative. The algae used consumed the oil and excreted water and harmless gases back into the environment (Gautam, 2012). Biotechnology companies have begun to isolate and farm these microorganisms as a crop (e.g. Alabaster, 2010). Similarly, specific varieties of fungi have proven effective at removing the toxins from industrial brownfield sites (Tortella, Diez, & Durá, 2005).

For a more common example, waste to energy has been touted as a more eco-friendly option, but it, too, creates environmental complications. Notably, beginning in 2006 Waste Management (WMI) released numerous advertisements highlighting its efforts towards environmental preservation. Over \$90 million was spent on TV commercials and print advertisements by WMI drawing attention to the practice of incinerating trash to create energy, known as waste-to-energy or WTE (Allen, 2009). Not only does incineration provide energy but there is also the potential to use the ashes produced in the creation of non-hazardous construction materials such as building blocks and reinforced concrete (Swanson et al, 2010).

Unintended Lifecycle Complications

The limits of this approach derive from its instrumentally political orientation. The underlying logic is that of aggregating disparate interests (the interest group view of politics). Green features are valued because they placate a significant constituency's interests, but there is little effort to modify or broaden those interests. Consequently the solutions are likely to be shallow and incremental. Not surprisingly, cleaning and containment solutions often prove inadequate over time. The primary focus of these efforts is on production and emissions, but there is usually more to the story than, for example, simply watching mountains of trash disappear in WTE plants, solving the bulk problem of garbage disposal. Unfortunately burning waste for fuel inevitably produces toxic air emissions and chemical ash residues, including: mercury, lead, and dioxin (Dijkgraaf et. al, 2004). WTE plants cannot be considered a green energy source since they generate more carbon dioxide per unit of electricity than do power plants run on coal (Haight, 2010; Tan, 2010). Also modern incinerators have been identified as a major source of ultrafine particle emissions responsible for a host of ailments including lung disease, heart disease, and cancer (Haight, 2010).

Moreover, many argue that there are serious indirect effects as well. Incineration discourages recycling since incinerator based power plants require a constant flow of garbage and thus can compete with composting, recycling and other forms of waste reduction for trash (Allen, 2009). In contrast, the lifespan of landfills can be significantly extended through aggressive waste reduction programs (Haight, 2010). Incinerators are also quite costly both to build (\$650 million per plant) and to operate often consuming billions of dollars of government money in subsidies that could have been applied towards investments in recycling and other forms of waste reduction for a tenth of the cost (Seldman, 2010; Tan, 2010). Approximately 90% of municipal waste can be recycled, re-used or composted and recycling saves three to five times the amount of energy that incineration generates (Haight, 2010; Tan, 2010).

Consequently the total environmental costs for incineration tend to have greater environmental impact than those for land filling per ton of waste unless both energy and materials involved so not produce toxins (Dijkgraaf & Vollebergh, 2004). These remediation strategies often address one problem while creating other direct and indirect negative environmental effects at different stages of the lifecycle.

Lean Green

These strategies target preventing some of the pollution in the first place, and are very popular among organizations with high processing costs and/or high waste (Orsato, 2006; Hart & Milstein, 2003). This eco-efficient strategic focus is both reactive and precautionary, complying with regulations and finding pre-emptive long term solutions to avoid further regulation and

restriction (Ginsberg & Bloom, 2004). Efficient processes, such as "lean" manufacturing initiatives minimize waste through continuous innovation (Wilson, 2009).

These types of initiatives tend to focus on the short to medium term profitability of specific waste-reduction and cost saving methods (Siemens, 2010; Trotta, 2010). The external validation of this "business case for sustainability" has greatly increased and there has been an explosion of books and articles advising managers on how to identify such profitable environmental initiatives (Holliday, Schmidheiny, & Watts, 2002; Schmidheiny, 1992). These efficiency initiatives can also be extended beyond the individual firm to include more of the value chain. For example, the Green Suppliers Network works with large manufacturers to engage their small and medium-sized suppliers in low-cost technical reviews that focus on process improvement and waste minimization (OPPT, 2010).

Possibly the most well known example of lean green technology involves alternative fuels for motor vehicles. The consumption of petroleum derived fuels is environmentally problematic because of the green house gases (GHG) they create. Collectively motor vehicles represent 60% of the world's total oil consumption, 70% of global carbon monoxide (CO) emissions and 19% of global carbon dioxide (CO₂) emissions (Vliet et. al, 2011; Balat, 2009). In dealing with this problem, one primary strategy, which, unlike other proposals, does not require radical redesign of the vehicle, is to simply switch from oil based fuels to bio-fuels (ethanol, biodiesel etc.), hydrogen fuel, electricity or synthetic fuels such as those derived from biomass, coal or gas - all of which feature less toxic emissions (Vliet et. al, 2011).

Among eco-friendly bio-fuels, ethanol is the most widely used alternative. It has several advantages over other bio-fuels, including that it can be mixed with gasoline and used in conventional combustion engines with virtually no modifications. Ethanol results in lower emissions of particulates, sulfur, nitrous oxide and other greenhouse gases when incorporated with conventional fuels and it has no net release of carbon dioxide when burned alone (Balat, 2009). Its inputs, crops, are a renewable resource which can be sustainably developed for future use (Balat, 2009). Moreover, as gas prices remain high and increasing, ethanol usage creates potential economies of scale and scope to the point where some analysts predict ethanol will become cost competitive with oil in the near future (Eisenthal, 2008).

Unintended Lifecycle Complications

Many managers in pollution intensive industries view and deal with issues of sustainability using this "clean brown" perspective. However, because of its focus on cost reduction via waste reduction, this approach is limited by the scope over which these are calculated. If the existing framework for calculating costs is left unchanged and externalized costs remain externalized, then environmental impacts may merely be shifted around rather than actually reduced. While

endeavoring to reduce toxic byproducts and looking for ways to manage the waste they do create managers overlook strategies in other lifecycle stages.

For example, the direct and indirect effects of ethanol production render its lifecycle eco-friendliness problematic, particularly in underdeveloped markets and third world nations (Balat, 2009; Singh et. al, 2011). Ethanol's primary claim to eco-fame - the environmental friendliness of the fuel's emissions - is tainted from a lifecycle perspective. Several studies have indicated that switching over to the ethanol production practices in the U.S. may actually trigger a net increase in global warming due to increased pollution emissions in the supply chain. This is largely due to the increased nitrous oxide emissions caused by the enormous amounts of nitrogen fertilizer used to grow ethanol corn [nitrous oxide is a GHG] (Mosier, 2009; Scharleman, 2008). In a comparative study of 26 different bio-fuels, 12 fuels, including U.S. corn ethanol and Brazilian sugarcane ethanol, proved to have greater environmental costs than fossil fuels when their lifecycle environmental impact is fully tallied (Scharleman, 2008; Balat, 2009; Valdes, 2011).

Another supply chain complication is the increased competition for water supplies due to the water requirements of corn. The National Research Council (Schnoor & Doering, 2007) reports in many regions the water necessary for drinking, industry and such uses as hydropower, fish habitat, and recreation will likely compete with and/or constrain the use of water for biofuel crops. Further, U.S. corn production uses more fertilizers, herbicides and pesticides, and results in more soil erosion and runoff contamination than any other U.S. crop. This pollution will be so massive, it is projected to increase the appearances of "dead zones" - low-oxygen environments lethal for most life forms - which plague large swaths of many regions of water including the Gulf of Mexico and Chesapeake Bay (National Academies, 2007).

One potentially catastrophic indirect effect is that the quantities of crops required cannot be grown without compromising food production (Davey, 2012; Walsh, 2012). Vast tracts of both native and farm land will reserved for ethanol crops, causing food prices to be driven higher (Pineiro et. al, 2009; Sharleman, 2008). This market-mediated response to increased bio-fuel production will translate into nutritional deficits among the poor (Hertel et. al, 2010). This problem is compounded when corn crop yields underperform, as in the U.S. failed corn crop of 2012 (Davey, 2012; Walsh, 2012). With climate change corn crops are not reliable. Furthermore, cellulosic ethanol, a biomass product using agricultural waste inputs that do not compete with the cultivation of food is unlikely to become commercially available for at least a few decades (Pineiro et al, 2009; Balat, 2009).

Systemic Green

This quadrant involves significant, system-wide restructuring of product service with green processes as a sustainable competitive advantage (Ginsberg & Bloom, 2004). This represents a significant investment in clean technologies, with the goal of being perceived by eco-conscious consumers as a truly green organization with a distinctive, credible, trustworthy green brand

(Orsato, 2006; Hart & Milstein, 2003). This commitment ranges from take existing products and processes and altering them with as many eco-friendly components and green inputs as possible, to developing entirely new, more eco-friendly processes and production.

Rather than increasing the efficiency of existing processes this type of innovation reconfigures processes to gain system-level efficiencies. Attending to system interdependencies can allow one to “tunnel through the cost barrier” (Hawken, Lovins, & Lovins, 2000). In manufacturing plants, for example, the decisions concerning equipment layout, and choosing a pump to drive fluids to the equipment have traditionally been made independently by different actors. However, it takes less energy to pump a fluid through a straight pipe than a pipe with many turns. By laying out equipment and installing pipes to minimize angles one can install a smaller, less energy intensive pump (Robbins & Page, 2012). Similarly, instead of sizing the HVAC unit for a new commercial building using standard calculations based on square footage, one can “first” invest in increased insulation that not only reduces heat loss but also allows installation of a smaller HVAC unit, saving embedded energy, materials, and money upfront as well as reducing ongoing energy usage (Hawken, Lovins, & Lovins, 2000). Note that such initiatives save energy even when the individual elements (such as pumps and HVAC units) are off the shelf items with only standard environmental performance.

Other innovations extend beyond the technical core to include organizational and governance issues. Benefit Corporations or “B-Corporations” have a social mission explicitly encoded in the corporate charter and submit to periodic audits on social and environmental performance (Robbins & Page, 2012). Already legislation in seven states recognizes B-Corps as a distinct corporate form. The end result is a governance structure that not only allows but mandates (under explicit threat of shareholder lawsuit) management attention to sustainability concerns (“B Corps,” 2012; Weber, 2010).

One widely used systematic innovation is genetic modification, which customizes inputs and outputs to maximize the green potential of the system. Are inputs environmentally "dirty?" - modify or replace them to become more eco-friendly with genetically modified organisms (GMOs). Does manufacturing processes create too much waste? Use GMOs to increase the yield of the inputs and to digest the waste. Higher quality inputs will also allow streamlining and downsizing production without sacrificing output. Is disposal an environmental problem? Not when GMOs transform the trash into harmless substances, or recyclable/reclaimable materials. GMOs are touted as having the potential to feed the worlds growing population, increase the availability of medicines and vaccines in a cost effective manner and to mitigate the effects of climate change (Hoffman, 2012; Marvier, 2007).

Food quality would be improved by GM crops through modifications allowing for changes in the protein and micronutrient content of staple crops. This could be used to battle vitamin and mineral deficiencies among populations unable to afford more than the basics for their daily caloric intake. Good illustrations of this technology are iron rich and beta-carotene rich rice

varieties (Bouis, 2003). Food security would also be enhanced through the introduction of crop varieties capable of resisting drought, pests, highly saline environments and disease as well as potentially providing greater crop yields and faster growth rates (Azadi et al, 2010; Bouis, 2003).

GM crops are also capable of manufacturing pharmaceuticals. Pharmaceutical producing plants can literally grow blood thinners, hemoglobin, insulin, growth hormones, cancer treatments and contraceptives. There is also further potential for the manufacture of hepatitis-B, cholera, rabies, HIV, malaria and influenza vaccines, and other therapeutic compounds. Producing vaccines in food plants eliminates the need for refrigeration, a limiting factor for many vaccines worldwide. Furthermore, using plants to produce these substances may reduce the risk of certain viral transmissions to humans via the drugs produced using animal cell cultures (Marvier, 2007).

In addition to these potential benefits to human populations there is the possibility that GM crops can reduce both pesticide use and green house gases simultaneously. Pesticide use on biotech crop areas has been significantly reduced in comparison to non GM croplands by as much as 8.7% (Brookes, et. al., 2011). GM herbicide tolerant crops reduce the greenhouse gas emissions associated with cropping agriculture since tractors no longer have to spray and till as often (Brookes et. al., 2011).

Unintended Lifecycle Complications

Since this approach is more cognizant of systemic interactions at the outset (and shifting these interactions is often the intended purpose of the innovation) we might expect it to be less susceptible to blind spots in the LCA than the previous approaches. Yet, as with the Multi-stakeholder Green and Lean Green quadrants, the focal innovators and the major players driving adoption may represent only a part of the system. In the case of GMOs there are a host of worrisome indirect effects. These include potential losses in the biodiversity of both crops and their wild counterparts as well as the contamination of both plants consumed by and areas inhabited by non-target organism. All of these unintended side effects would come as the result the free flow of transgenic crop genes among plant relatives (Gepts et. al, 2003). This is especially important because domestication has resulted in the dramatic bottleneck of genetic diversity among most crops so these wild relatives are the only remaining biodiversity reservoir from which to draw. Many crops, including 12 of the 13 most important crops harvested globally, can easily cross with their wild forebears creating viable and fertile hybrid offspring. This leaves the door open for genetic assimilation or extinction due to the supplanting of wild allelic diversity with transgenes (Gepts, et. al, 2003).

Further, such genetic flow could result in increased numbers of weeds with herbicide resistance. Examples of wild relative crop weeds that could gain pesticide from their crop kin include red rice (a weed of rice) and shattercane (a weed of sorghum). Moreover, such contamination could spell the end of effective herbicide use as a tool for controlling weeds (Gepts, et. al, 2003). The

spreading of genetically modified traits from crops to weeds is well documented and can result in these plants becoming “super weeds” (Hoffman, 2012). Insects are also rapidly developing resistance (Callahan, 2011).

Possibly of even greater concern is the potential escape of genes from the “pharming” crops. Genes dealing with the manufacture of pharmaceutical substances escaping would be of particular concern because several of these crops have been engineered so that vaccines can be delivered through the direct consumption of the crops leaves, fruits or other plant parts without any processing whatsoever (Marvier, 2007). Many such crops are grown in open fields where it is impossible to contain the dispersal of their transgenes via pollen. This can result in the contamination of not only food crops bound for human or livestock consumption with pharmaceutical compounds, but also the wildlife feeding on non-domesticated crop relatives. Underlying these risks is the fact that contamination of crops bound for food manufacture by pharmaceutical crop transgenes has already repeatedly occurred (Marvier, 2007), as has the contamination of crops with GMOs not approved for human consumption (Vogel, 2006). This is particularly serious in under-developed regions that typically lack the capacity to comply with the basic safety regulations occasions (Azadi et. al, 2010; Vogel, 2006; Marvier, 2007).

In the end GM crops have not lived up to their eco-potential, particularly in lowering pesticide use and higher crop yields. In recent studies it has been found that pesticide use has not in actuality been significantly reduced by GM crop utilization. This is due to the rise of secondary pests which require secondary pesticides, the perfect example of an unforeseen ecological change resulting from GM crop cultivation. In a study of GM Bt toxin cotton crops there was no difference in the total number of insecticide applications between non-transgenic cotton and GM varieties (Azadi et. al, 2010). Furthermore, a greater part of GM crops do not actually result in the higher crop yields, which depend on optimal conditions simply not present in most locations.

Holistic Green

Many managers are reluctant to adopt green innovation strategies unless there are clear cost benefits from doing so because such short term investments for long term returns are considered risky in corporate environments where performance is judged based on short-term quarterly returns. However, for the adventurous, a holistic integration of green into entire product lifecycle on a global scale is worth tackling because of the growth potential it offers (Ginsberg & Bloom, 2004; Hart & Milstein, 2003). Designing a business model around the needs of the environment, instead of retrofitting existing models to be more eco-friendly, is radically innovation and equally risky. On the other hand, such offerings are likely to command premium prices and industry leadership to those firms brave enough to pursue them (Orsato, 2006). These corporations use green innovation strategies as a competitive advantage and are the most likely to receive government support for their efforts. Siemens (2010) cautions that such models are strategically imbalanced, compromising productivity in favor of the environment, and are thus not likely to be viable in the longer-term (Siemens, 2010, Trotta, 2010).

According to the USDA National Organics Standard Board (NOSB) organic agriculture is defined as farming practices that “promote and enhance biodiversity, biological cycles and soil biology activity.” This includes soil management, crop rotation and fertilization techniques free of chemically manufactured products (Richford, 2010). Organic farming takes the medium to long term effect of agriculture on the environment into account. It aims to produce food while establishing an ecological balance to prevent loss of soil fertility or pest problems rather than treating the problems after they occur as in traditional farming methods (Food & Agriculture Organization of the United Nations, 2013).

There are many environmental and health benefits associated with organic farming. Crop rotation and fertilization techniques used in organic farming encourage soil fauna and flora biodiversity, improving soil formation and structure as well as leading to a more stable system less prone to soil erosion. As a result of this nutrient and energy cycling is increased and the ability of the soil to retain nutrients and water is enhanced. Furthermore, while with conventional farming methods water pollution by pesticides and fertilizers is a major problem organic farming lowers the risk of groundwater pollution significantly. This is due to the better nutrient retention of the soil and the use of organic fertilizers. Organic farming practices have also proved useful in lowering agrochemical needs, which require large amounts of fossil fuels to be produced, and carbon sequestration in the soil. Soils organic carbon content under organic farming methods are considerably higher than those found under conventional methods because organic farming practices increase the return of carbon to the soil, raising productivity and increasing carbon storage (Food & Agriculture Organization of the United Nations, 2013). Lastly, foods produced organically are safer to eat than those made traditionally. This is in large part due to their containing far less pesticide residue. Organic food production also bans/severely restricts food additives and other chemical food treatments (Richford, 2010).

Unfortunately, certified organic products can be cost prohibitive. They are generally more expensive than their conventional counterparts due to a limited supply compared to demand and higher production costs. Furthermore, since organic products are dealt with in relatively small quantities post-harvest handling, marketing and distribution for organic products is inefficient and costs are higher. Beyond this the cost of organic products includes not only production costs themselves but also an array of other factors not captured in the price of conventional food such as: environmental enhancement and protection, higher standards in animal welfare; avoidance of health risks to farmers from pesticide exposure and rural development from additional farm employment with fair income to producers (Food & Agriculture of the United Nations, 2013).

To be certified organic in the U.S. the use of insecticides, fungicides and herbicides on the products are prohibited. Further, farmers are not able to claim organic status until the land used to grow the produce/livestock has been pesticide-free for at least three years before harvest. One rationale for organic certification is to safeguard against the kinds of self-interest or narrowed horizons that undermine initiatives in the other three quadrants. Though this does not eliminate narrow and self-interested motivations it at least moves decision making into a public forum that mandates (via administrative law) consideration of wider issues and constituents. Yet a positive

outcome is not guaranteed. Unfortunately, there has been a relaxation in federal standards with the USDA significantly expanding their list of non-organic ingredients which are acceptable in organic foods. Originally 5% of a USDA-certified organic product could consist of non-organic substances as long as they were on the approved inorganic substances list of the NOSB. However, this list has expanded from 77 to 245 substances since it was created in 2002 allowing numerous companies to obtain the "USDA Organic" seal on many products despite their inorganic additives. For example, organic beer can now be made from non-organic hops (Kindy & Layton, 2009).

There have also been significant downgrades in standards dealing with pesticide use in organic product production. In 2004, USDA released a directive allowing farmers and certifiers to use pesticides to grow organic crops if "after a reasonable effort" they could not determine whether the pesticide contained chemicals prohibited by the organics law. The USDA also granted producers of organic livestock permission to feed their livestock non-organic fish meal, which can contain mercury and PCBs while still using an organic meat label (Kindy & Layton, 2009). Taken all together the seal of organic under these standards becomes more dubious as large corporations take over the organic product market. Organic food has become a highly profitable business for Big Food which can charge premium price for their organically labeled goods and has assumed an increasingly larger role in setting the standards for what can and cannot be labeled organic (Strom, 2012).

IMPLICATIONS

The need for the world's industrial companies to transform "from a dead end, eighteenth-century model into a new, sustainable model suitable for the twenty-first, may well be the greatest business opportunity that industry and entrepreneurs have ever seen" (Anderson & White, 2009, p. 212). There is a definite need for new companies to enter the market who already have the knowledge needed to identify new ways to create innovative products from those things which were once another person's trash (Perman, 2006). Environmentally-focused entrepreneurs have an added advantage because they are able to differentiate their businesses and offerings from those companies who are choosing to simply ignore the environmentally sound buying habits of today's consumers (Williams, Brooks & Page, 2011).

Despite this new reality, the strategy of going "green" represents a moving target. As we have seen, while there is some consensus on general strategic goals, there is much more variation in terms of the recommended operationalization of those goals into specific strategic initiatives. Standards are continuously evolving and sustainability varies widely depending upon the product lifecycle stage being analyzed, as well as indirect effects from the supply chain (Ny et. al., 2006; Sikdar, Glavic & Jain, 2010). Further, environmental impact categories are sometimes neglected or manipulated in streamlined life-cycle studies through:

- over-reliance on previously completed life cycle assessments often ignores their limitations and blindspots.
- using pre-existing data on energy use depends on the problematic assumption that products which require little energy do not create serious process wastes.
- focusing on toxicity ignores a host of environmental issues involving the bulk and composition of non-toxic wastes, particularly fine particulates.
- omitting certain product components or materials as insignificant due to the small relative weight of the discharge masks the impact of small amounts of highly toxic material.
- omitting certain lifecycle stages, particularly the direct and indirect effects of the supply chain and disposal activities.
- using economic value to assess resource scarcity and ease of manufacturing.
(Bansal & Hoffman, 2012; Ny et. al., 2006; Rosselot & Allen, 2000)

Unfortunately, the selective nature of streamlined life-cycle studies means that potentially important environmental impact categories are sometimes neglected. When streamlined life cycle criteria exclude environmentally destructive direct or indirect effects of the supply chain or production or disposal, accusations of deliberate manipulation surface. This social negotiation naturally creates the possibility of marketing manipulation, commonly referred to as "greenwashing" (Greer & Bruno, 1997; Orange, 2010; Ramus & Montiel, 2005). When products and services "promise more environmental benefit than they deliver," that promotion is an example of "greenwashing" (Dahl, 2010, p. 246);

Greenwashing has become common in recent years, primarily due to a lack of regulation, oversight and monitoring of green marketing claims (Dahl, 2010; Ramus & Montiel, 2005). In the United States and Canada, a total of 2,219 products making 4,996 green claims were tested by TerraChoice Environmental Marketing (2009) against best practices, mainly against guidelines of the U.S. Federal Trade Commission, the Competition Bureau of Canada, the Australian Consumer and Competition Commission, and the ISO 14021 standard for environmental labeling. The sampled companies increased advertising claims of green products by 79 percent in a 2 year period, while only 2% of those 2,219 products had the eco-friendly design features and production changes needed to justify their claims.

To the extent that corporate environmental policy statements are not transparent, accessible, and independently verified by credible third parties, the relative effectiveness of the different strategic approaches identified here may never be known - it will be difficult to separate fact from fiction. When Ramus and Montiel (2005) investigated whether public commitment to "green" policies translate into meaningful implementation, the results were not encouraging - commitment to specific environmental policies was relatively consistent across industries, but policy implementation varied widely. As interpretations of "green" product/service criteria become too creative, consumers are becoming increasingly skeptical of "green" claims. The concept is in danger of being marginalized (Orange, 2010).

Consequently, even the lifecycle model may prove inadequate in assessing where products and services are truly green. Current research is moving away from models of linear industrial throughput in which raw materials are extracted, fabricated into products, consumed, and then discarded as waste. Instead the natural environment becomes the fundamental context in which human economic activity occurs, and such activity is dependent upon the health of the environment to an ever increasing extent (Robbins & Page, 2012). More broadly, approaches that draw on systems thinking (Martin, Brannigan, & Hall, 2005) advocate taking into account the various closed loops and complex interdependencies of the natural environment, either as a way to anticipate the behavior of the natural world or as forms of activity to be emulated as fully embedded and dependent on it (Robbins & Page, 2012). The linear lifecycle is recast as a circular amplification loop. Whether this perspective can ever become truly compatible with a "business case" for sustainability remains problematic, and will continue to remain a fertile field for further research.

When it comes to sustainability, consensus tends to occur only when those green ideals remain general, ambiguous, and unanalyzed abstractions. Researchers and practitioners alike are seldom secured in their visualization of what comprehensive, economically feasible, pragmatic "true green" looks like, and their implementation initiatives tend to cause as much controversy as clarity. As the adage notes, "one man's heaven is another man's hell." This same insecurity is manifest in most public policy.

The characteristics of the strategy support and encourage the analyst to identify situations or ills from which to move away rather than goals toward which to move. Even short term goals are defined largely in terms of reducing some observed ill rather than in terms of a known objective of another sort. Policy aims at suppressing vice even though virtue cannot be defined, let alone concretized as a goal; at attending to mental illness even though we are not sure what attitudes and behaviors are most healthy at eliminating inequities in the tax structure even though we do not agree on equity (Braybrooke & Lindbloom, 1963, p. 102).

Given this level of complexity, green sustainability seems trapped in Bonini's paradox: As a model of a complex system becomes more complete and realistic, it loses simplicity and clarity. It tends to become so complicated it is just as difficult to understand as the complex real-world processes it represents (adapted from Starbuck, 1976). In other words, the simple models we often find so compelling unfortunately do not capture enough of reality to be considered accurate.- if they did, they would not be easy to understand. Hence the sociological maxim: "All models are bad, but some are useful." In the absence of adequate, clear models "green" will continue to inhabit a retrospectively rationalized world.

This makes the definition of "green" a socially constructed as much as empirically based assessment. Notice that in the competing values model of green initiatives, three of the four quadrants (multi-stakeholder green, systemic green and holistic green) explicitly include marketing campaigns to build competitive advantage. It is no longer enough to develop green

products and processes; they also require the support of a public relations campaign to make a credible claim on a green reputation. Standards and regulations will be socially negotiated political mandates arising from crisis management and environmental brinksmanship.

In the end that leaves the business case for sustainability - the environment should be treated as one of a number of stakeholders, whose legitimate needs and interests must be balanced against each other. While there certainly is a case for holistic green, it is unlikely to be more than a niche strategy because of the costs and difficulties involved. Siemen's conceptualization of eco-care, explicitly argues that some strategic initiatives are "too green," they sacrifice too much productivity in their quest for eco-friendliness. But only to a point, eventually troublesome direct and indirect effects of product/service lines will become increasingly noticeable as their consequences become increasingly more troublesome and costly and no longer minimized or ignored.

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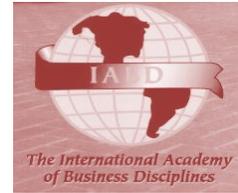
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INTERNATIONAL JOURNAL OF INTERDISCIPLINARY RESEARCH

VOLUME 2, NUMBER 2, December 2013

ISSN 2165-3240



**A PUBLICATION OF FROSTBURG STATE UNIVERSITY AND THE
INTERNATIONAL ACADEMY OF BUSINESS DISCIPLINES**

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