MARKETING GREEN BUSINESS

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Abstract

A large number of businesses have implemented sustainability and corporate responsibility programs in the last five to ten years, mostly in the absence of immediate regulatory or carbon pricing pressure. In this paper, I examine the incentives for companies to engage in these sustainability efforts a part of "business as usual," and the degree to which programs for marketing these efforts build on "marketing as usual." The business incentives arise from a "leveraging" of business' environmentally-aware customer segment, and contribution to risk control for brand portfolios in the social media age. In the conventional context of the "four Ps" of marketing – product, price, place, and promotion – key characteristics of green products and services are transparency, reversibility, lifetime, and customer immediacy. I propose that, since risk is a common dimension underlying these key characteristics, a fifth "P", Probabilities be considered alongside the four Ps. A mini case study of Monsanto's roll-out of genetically modified (GM) seeds in the mid-1990s is presented, and the marketing problems that were encountered are discussed in the context of GM product characteristics and the "fifth P". Aqua Bounty's current effort to introduce genetically modified salmon to U.S. markets is analyzed along the same lines.

1. Introduction

In this paper, I focus on marketing and its role in "selling" the products of the green innovation and technology in a marketplace in which greenhouse gas emission externalities exist -- "the greatest market failure the world has seen" in Nicholas Stern's famous words. While regulatory restrictions on emissions, carbon tax, and cap-and-trade initiatives for controlling these emissions are currently stalled, many companies seem to be moving ahead with serious sustainability and corporate social responsibility programs. Indeed, one might

reasonably conclude that "the train has left the station" as regards companies' embrace of such programs – sustainability in many guises is becoming "business as usual" as McElhaney（2008）and Vogel（2005）report.

I first examine the incentives that potentially induce business to undertake sustainability initiatives. Beyond the so-called "win-win" endeavors, e.g. Walmart and General Electric point to large savings in both costs and emissions, I discuss the situation in which a segment of clients derives utility from buying environmentally-responsible（"green"）products which doesn't serendipitously also lower costs. The marketing promotion of these products needs to be successful in inducing the consumer segment to pay a commensurately higher price for differentiated green products and services, in the face of evidence that consumers as a whole are not willing to pay higher prices. I discuss how a marketing program for sustainability makes an additional contribution if it can be leveraged beyond the sustainable products per se to a company's entire portfolio of brands, and how the new-age networked social media may increasingly facilitate that. However, the same always-on-everywhere social networking that enables a company to leverage its sustainability program is a double-edged sword: It can also leverage risk on the downside for a brand portfolio when bad publicity goes viral. In the event of the latter, the "responsible company" image is potential insurance, not just for the sustainable brand, but for the entire brand portfolio. The insurance role has been put forward before, e.g. the *Economist*（January 7,2008）argued that: "…most of the rhetoric on [corporate social responsibility] CSR may be about doing the right thing and trumping competitors, but much of the reality is plain risk management. It involves limiting the damage to the brand and the bottom line that can be inflicted by a bad press and consumer boycotts, as well as dealing with the threat of legal action."

It might appear then that sustainability initiatives that can be construed as "business as usual" as above also involve "marketing as usual." However, I further argue that risk is an important additional dimension to "the four P's" of marketing-as-usual – product, price, place, and promotion – when it comes to green product marketing. Perhaps a fifth P for "Probability" expressing risk, can be added to the four P's in the case of marketing for green business! This extra P in the green product marketing captures something quite distinct from the risk of viral attack on the corporate just mentioned. Specifically, the fifth P involves consumer risk arising from the key attributes of many green products: For green products and services to be marketed effectively, transparency as to carbon footprint throughout a long supply chain is

required -- there is not much satisfaction for an eco-friendly consumer in driving an electric car if 100% of the electricity is generated in old high-emission plants and battery production is a source of emissions. While measurement and display of carbon footprints has been developing rapidly, the longer the supply chain, the higher the risk of potential estimation error. When the "green tech" product involves high tech, e.g. bio-engineered food from genetically modified (GM) seeds or steaks "grown in the petri dish," there is a potential product risk to the consumer, creating the need in the marketing program for further enhancement in transparency. Reversibility in use of the product is another feature that is relatively more important in the case of green products, e.g. does the bio-engineered food contain an as-yet-unknown toxin? Immediacy to the customer is also arguably lower for many green products, e.g. genetically modified seeds, electricity produced upstream by clean generators. So the emphasis on building a strong customer relationship will be a more important in marketing promotion for sustainable products.

I use the "mini case study" of the introduction of GM foods to illustrate how the features of GM seeds --- transparency, reversibility, immediacy to end consumer – were missing from the marketing program; indeed, even a well-thought-out targeting of end consumers was missing in that case.

The outline of the paper is as follows: In the next section, I discuss how "marketing as usual" with necessary twists for green business, can incent companies to engage in green business initiatives even when they don't directly pay for themselves as in the win-win case. From a social point of view, the marketing-driven incentives can play a role in "plugging the market failures" *sans* cap-and-trade, carbon taxes, etc. In Section 3, I discuss more fully the characteristics or attributes of green products and services that I believe will need to be important points of emphasis in marketing promotion. I also propose a measure of transparency, one of the key characteristics. In Section 4, I argue that the introduction of genetically modified foods stumbled so badly in part because their promotion failed to take these characteristics into account. Section 5 contains a summary and discussion.

2. Role for Marketing Sustainability

I take as given the current state of carbon emissions[2)] and regulatory framework. Clearly, in an idealized world in which cap-and-trade or carbon taxes were in place globally, the market

failure and emission externalities would ipso facto be remedied. The invisible hand would work to incorporate emissions reduction in production and consumer decision-making, and to stimulate green tech innovation[3]. Green business would indeed become "business as usual." As it is, the momentum toward cap-and-trade or carbon taxes seems to have stalled along with most global economic growth rates; even if the momentum to price emissions externalities was still there, the revised regime would likely contain implementation imperfections,[4] and the marketing incentives would still perhaps play a role in restraining companies from exploiting those imperfections.

In the world as it exists today, the most straightforward green marketing situation is the so-called win-win one, in which a business is able to make emissions-reducing changes in its product design, operations and/or technology that also save money. If taken literally, and provided that the financial analysis is done correctly,[5] this win-win situation might more aptly be termed one of "silly externalities" or unexploited opportunities: the business was throwing away money before changing! Win-win is often described as a case of "doing well by doing good," but it could better be described as the "stop hurting oneself to make the environment worse off" case -- as Amory Lovins once quipped, this is the case in which the adopter gets more than a free lunch, one actually gets paid to eat the lunch!

One level up in marketing difficulty is the situation where there is an additional cost to supply and market a sustainable product or service, but where there is a segment of customers who will pay more for it. At first blush this case might seem exceptional, since there is a paucity of empirical evidence that consumers are indeed willing to pay a higher price for corporate socially responsibility as an attribute of products and services (e.g. Devinney et al. (2006)). However, if a segment of say 10% of potential customers is willing to pay a premium for environmentally friendly products like a hybrid car, then a marketing program might profitably brand cars for this segment in a way that emphasizes their "social respectability." The combination of the "four Ps" of marketing – price, product, place, and promotion need to be involved: e.g. promotion of an all-electric sports car with Ferrari-resembling design at a price that covers the battery costs; a hybrid Prius with family versatility and eco-friendly credentials. The role of the marketing program is to convince the buyer that the price is not high given the eco product and "cool" design!

I argue that a key feature of product design that is on average likely to be more important

in the case of green products or services is transparency in the production process and technology. If a product's carbon footprint is an all-important feature of a green product, it needs to be assessed all the way upstream in the supply chain – an intelligent consumer who attaches utility to emissions control can't derive much comfort in driving an electric car if 100% of the electricity is generated in dirty coal plants and battery production is polluting. In contrast, when emissions externalities are not an issue, the market's invisible hand often enables consumers to ignore the details of the supply chain. Transparency plays a similar role to "trust," or "trust but verify," or "customer relationship-building" in a conventional marketing program. Transparency and social media are arguably mutually reinforcing: For example: "… maybe a peek into the normally opaque systems that manufacture the wares of well-known brands does make a difference…it's the specificity that matters; knowing something about a particular laptop or pair of sneakers or pet food resonates with consumers…Imagine an open-source effort emerging to make [the] brand / production relationship much less opaque than it is…that…would change the way brands scrutinize their supply chains if they knew that everything we buy was really, truly transparent"（*New York Times* magazine June 27, 2010, p. 18）.

All else equal, transparency in carbon footprints is lower for products and services that have long supply chains and byproducts. There are various measures -- "cradle-to-grave," "life-cycle," or "end-to-end" boundaries on the supply chain when assessing carbon footprints – and room for disagreements. For example, Ball（2009）reports that "Timberland's carbon footprint calculations have prompted spats with some of Timberland's leather suppliers...They argue the carbon hit from a cow should fall not on their ledger, but on the ledger of beef producers. The leather producers reason that cows are grown mainly for meat, with leather as a byproduct, so that growing leather doesn't yield any emissions beyond those that would have occurred anyway. But Timberland has determined that 7% of the financial value of a cow lies in its leather."

Whilst a long supply chain of multiple products can't be uniquely decomposed by carbon footprint, and estimation is undoubtedly not perfect, the perfect has not been the enemy of the good: substantial progress has been achieved in product coverage in the last five to ten years, which is in turn consistent with my hypothesis that transparency with respect to this carbon footprint is important for the sustainability-sensitive customer segment. One example is substantial emissions analysis described in Chocteau et. al. (2010): "La Poste… [uses] a

management framework and related metrics (e.g. its carbon footprint) for sustainability [that] have been in place since 2006" (p. 26). The non-profit Cradle to Cradle Products Innovation Institute in San Francisco, newly-launched by the co-founders of environment consultant McDonough Braungart Design Chemistry (MBDC)), aims to "…promote an innovation-oriented model for eliminating toxic chemicals and other negative environmental impacts. The Institute prescribes a set of design principles, based on the laws of nature, to help businesses create products that are safe for people and the environment."

Next, I consider companies with entire portfolios of brand-names rather than an assumed single sustainable product. McElhaney (2008) presents several examples of companies whose CSR programs appear to be simply "good business" in which marketing plays a strategic part. GE's *Ecomagination* program, which is often marketed as an example par excellence for a company that is "doing well by doing good," reportedly originated with two people, the CEO and the Chief Marketing Officer – not the CEO and the Chief Financial Officer! The importance of managing the brand portfolio was emphasized by David Aaker (2004). Arguably brand portfolio management is more important than ever where "…the social world is one where nearly everything -- from the web to the television to the restaurants you choose to eat at – is informed by your stated preferences and your friend's preferences, and the technology that lets you communicate and share content with people you know."[6] The same "new world" challenge for marketing was posed by well-known marketer Peter York (Peter Wallis): "Back in 1982, Levitt's *The Marketing Imagination* defined a way of looking at the world and doing business in it: an instinctive belief that the route to growth and profit lay in looking outside the business, understanding and satisfying customers, producing what they wanted, building brands ('beach-heads in the mind') that would command premiums (higher prices) and loyalty…if we're entering a brave new world of marketing, it's one obviously saturated by the language of the industry. It's a world where the quintessential scenario of 21st-century self-branding, the digital equivalent of the old 30-second television commercials, is your very own YouTube series…"[7] The world with instantly networked "self-branded" consumers is, from the company's point of view, like one in which each consumer is a potential minor self-branded "celebrity" endorser or critic.

The same all-connected-all-the-time social network that enables a marketing program to potentially leverage branding in a sustainable segment of its market to its entire line of product and services brands[8] is double-edged, just as is financial leverage: if a calamity affects one of

the company's brands, it is also a source of downside risk for the company's entire line of brand names. If a company's problems "go viral" on the Web[9], we could interpret that to mean quantitatively that "correlations between the values of branded products increase." The resulting impact resembles that of contagion in a financial crisis where correlations between values of different asset classes increase: to see this, first suppose that there is a 10% independent risk of any one of a company's (let's say) equally valuable brands coming under attack. The portfolio risk across 10 brands would be 1%. Next, suppose now that there is a 20% chance that an attack on one brand spills over in the new media to other company brands -- the portfolio brand risk goes up to 3%, i.e. it is 3 times higher. If the social media leads to an attack "going viral" and the correlation suddenly jumps up to say 50%, then in the "catastrophe scenario," the brand portfolio risk is suddenly 6% -- 6 times the risk in the absence of portfolio brand effects.

The stabilizing influence of socially responsible products and services and their marketing means that it in essence those endeavors contribute to risk mitigation at the corporate level. This idea that CSR reputation building is a form of risk mitigation is not new, although the levered effect on a company's image in the always-on-socially-networked information age does not seem to have been explicitly recognized. For example, the *Economist* argued in 2008 that: "Most of the rhetoric on CSR may be about doing the right thing and trumping competitors, but much of the reality is plain risk management. It involves limiting the damage to the brand and the bottom line that can be inflicted by a bad press and consumer boycotts, as well as dealing with the threat of legal action" (January 7, 2008). Minor (2010) offers event-study evidence for the *Economist* position: in a sample of 194 company product recall events, he found that those companies with a higher CSR rating experienced a smaller decrease in their stock prices, to the extent that all else could be held equal. There are various other studies showing that companies with more sustainable practices have higher credit ratings or less stock market risk, and also some direct evidence that brand trust is important when consumers are segmented by risk aversion, e.g. Matzler, Grabner-Krauter, and Bidmon (2008).

3. Promoting Green Tech: Important Product Attributes

In the previous section, I discussed the incentives for businesses to promote sustainability initiatives *sans* direct regulatory pressure, cap-and-trade, or the like. The role for corporate marketing arises from the power of the citizenry *qua* consumers in contrast to the power of the

citizenry *qua* voters for regulation. My discussion has focused in part on the normative – what is the motivation for businesses to develop green initiatives and concomitant marketing programs – and in part positivistic – what characteristics of the green products are likely to be important in the marketing program. In particular, transparency in the supply pipeline for a product or service with respect to its carbon footprint is a key feature. In this section, I further examine transparency and examine other potentially important product characteristics which are likely to be important for a green marketing program.

The following are the characteristics:

- The transparency of the technology. Transparency has multiple dimensions. One was mentioned above: ability to trace a carbon footprint back through a product's supply change. But even if the carbon footprint had been accurately measured, a genetically-modified food that involves say state-of-the-art biotech where it is difficult for the end-consumer to understand the science and the toxicology tests obviously carries a higher perceived risk, all else equal. Since much of the type of innovation that is regarded as most likely to contribute to sustainability involves "using nature" in growing circuits, nanotechnology, etc., we can expect green products to be less transparent in this dimension; even when segments of risk-averse consumers may like to support the technology, they have to be "sold" by finessing the lack of transparency. Protection of IP may exacerbate transparency problems. On the other hand, for products with components that are generally accepted as standards, or that carry endorsements, the problem is ameliorated.

- The "reversibility" of using the product. If the product is a foodstuff that is ingested and has even a slight chance of causing irreversible health problems, its risk as assessed by an end-consumer will be higher than that of a non-food product whose technology is of equivalent transparency, e.g. an electric drive-train automobile. A warranty will help reduce early-adopter risk in the latter case, but is not likely to do so in the former. Accentuating this is the behavioral research that suggests that individuals tend to over-react to the probability of extreme adverse events.

- The immediacy of the product and service to the end-consumer. For a given level of reversibility and transparency, the more readily that a marketing program can build a

rapport with the customer, the more valuable it is. In the case of say genetically modified (GM) foodstuffs or electricity generation, the "manufacturer" of the product is more distant from the customer in the supply chain. Evidence, e.g. that of Delmas and Toffel (2010), supports the proposition that companies with products and services closest to retail customers adopt more environmentally friendly practices.

・The life of the new product or service. Length of the life has three potential consequences: (i) A long-life product involves higher uncertainty of far-into-the-future benefits; (ii) Comparison of the NPVs of long-life alternative investments, e.g. solar panels, against those of shorter life alternatives, involves an assumption about technology change over the incremental life of the long-lived alternative – simply put, going with a short-term alternative offers the valuable option of waiting to see what next year's technology brings; (iii) an investment decision is bundled into the purchase decision. Thus, in offering its battery change service for conforming electric vehicles, Better Place plans to rent its batteries to electric vehicle owners with a rental fee that roughly equates to what a motorist would otherwise pay for gasoline – this takes the required "investment" dimension out of the buy decision for the battery service.

Turning to an example, genetically modified foodstuffs that are discussed in Section 4, the underlying bio-technology is non-transparent, and since the foodstuff is to be ingested, it poses some danger of irreversible health effects. The unknown toxicity risks would likely be higher for young children, suggesting a segmentation of customers by family-type. Marketing should emphasize end-consumer assurance and "education" to the targeted end-consumer -- for example, if retailer branding creates more affinity with the customer than a manufacturer's brand, the marketing program should put a higher weight on the former.

One additional albeit unusual piece of evidence that suggests a prominent role for marketing and branding the above attributes for products and services of a "green tech revolution" is Richardson's (2010) evidence that in a previous "revolution" in industry – the industrial revolution -- there were: "… intensive efforts to control quality. Guilds of manufacturers inspected members' merchandise, prohibited sales of shoddy products, and punished members caught selling defective output. These efforts enabled the organizations to consistently sell defect-free merchandise and establish reputations for doing so. Good reputations assuaged consumers' fears about purchasing products with hidden defects and

encouraged consumption of manufactured merchandise. Step two involved selling ［branding］ merchandise with conspicuous characteristics. Examples of these unique, observable traits included cloth of a distinctive color, fabric with an unmistakable weave, and pewter which when tapped with a spoon resonated at a particular pitch." There is a clear parallel between the guilds and various bodies today like Underwriters Laboratories and the non-profit bodies certifying organic foods and carbon footprints.

The automobile industry provides a specific example of how the "green revolution" product characteristics could indeed be reminiscent of those depicted as conspicuous for the "industrial revolution version": there are a plethora of levels of car brands that segment the market by luxury image, sporty image, "muscle car" image, etc. If a relatively standardized electric motor replaces the ICE drive-train of the family sedan and the muscle car alike, the demands for branding for the "car appliance" will presumably shift to design and other premium characteristics of the car with their respective customer segments. For example, "a survey last year by Bain of 4,000 car owners in the United States, Europe and Asia found that premium-car buyers were more willing than those in other segments to invest in green technology. But they also wanted their low-emission cars to look cool."[10] That is, there appears to be a "green-tech, cool design" customer segment, and "cool" will likely be increasingly defined in the social media.

For "transparency" to be useful as an attribute in marketing programs, it needs to be more precisely defined. Intuition suggests that a supply chain would contribute to reduced transparency, all else equal. It is not just the length of the supply chain that is important. For example, a television set has a myriad of components. But in principle one could assemble the television from available components, i.e. its technology is transparent. I propose a measure of transparency that follows the one for complexity of a country's economy used by Hausman and Hidalgo (2009). Here, the units are products and the observable inputs that go into the product. We define an "adjacency matrix" $M_{P,I}$ similarly to Hausman and Hidalgo, i.e. $M_{P,I}$ if product "P" contains a significant fraction of input "I", and 0 otherwise. Product "P" has a significant fraction of input "I" if the share of the input in that product is greater than the share of the input in all products. Then Hausman and Hidalgo's "method of reflections" to identify a network of connections between products and inputs is obtained by iteratively calculating the averages of "K" values calculated as follows:

$$K_{P,N}=\frac{1}{K_{P,0}}\sum_{I} M_{P,I}K_{I,N-1}$$

$$K_{I,N}=\frac{1}{K_{I,0}}\sum_{I} M_{P,I}K_{P,N-1}$$

where: $N \geq 1$.

Here, $K_{P,0}=\sum_{I} M_{P,I}$ is the observed length（the inverse of "concentration"）in the supply chain, and $K_{I,0}=\sum_{P} M_{P,I}$ is the ubiquity of the input. If more concentrated supply chains use less ubiquitous inputs, I deem the products coming out of the supply chain to be less transparent. If the K measures were to be estimated empirically across a range of products, we would need to be able to define and observe inputs.

As applied here, the transparency measure takes into account the degree to which the components in the supply chain are separately traded. Applied to products like a television set or an automobile, the measure says that they are quite transparent – most of the components can be understood on a stand-alone basis and, with sufficient time, the knowledgeable end-customer could understand their assembly. On the other hand, the end-foodstuffs that incorporate transgenic vegetables grown from Monsanto's GM seeds are not transparent – the gene insertion techniques for the seeds, and thus for the crops, are not well-understood and observable on a stand-alone basis. The particular case of GM seeds is discussed in detail in Section 5.

To further understand the transparency measure, consider the electricity industry. It shares both similarities and useful contrasts with the food supply industry. With respect to similarities, both have long and less-than-transparent supply chains: In the case of electricity, it is generated, then fed into a grid, then distributed by retail utilities, and then finally used in lighting, cooking, etc. to produce consumer enjoyment. One could argue that the most promising technology for reducing the carbon footprint of each -- genetically engineered crops in the case of food products, and nuclear power in the case of electricity generation – both have an "image" problem, i.e. a branding problem. Also, both foodstuffs and electricity are perishable. At the same time, electricity is a homogeneous string of electrons primarily purchased by industry, the owners of office and apartment buildings, and single-family residences, while foodstuffs are typically distributed by supermarkets and stores, either raw or processed and packaged（farmers' markets and the like aside）. The most important carbon emissions from

the electricity industry occur far upstream from the end-consumer, at the power generating plant, and they are not transparent to the end-consumer plugging in an appliance. Whenever the electricity is bought from the grid and not obtainable separately as a component of the end product electricity, the measure for transparency is lower. It doesn't matter how much Internet access is available to the end-consumer of electricity! Also, end-consumers of GM foodstuffs could, if all were persuaded by marketing to switch to those foods, help save the planet! But an end-consumer of electricity from the grid cannot make a similar direct impact in the choice of plant type of a given "dirty" generator.

4. Marketing Genetically Engineered Crops: A Mini-Case-Study in How Not to Do It

Crops involving genetically modified organisms (GMOs), also referred to as genetically-engineered or transgenic crops, have been the subject of enormous controversy since their introduction in the U.S. by Monsanto in the form of soybean seeds that were genetically modified to resist Monsanto's herbicide Roundup. Using a "by-the-numbers" metric, the introduction of GM foods can now be regarded as a success: some "91 percent of the soybeans grown in the United States in 2009 were herbicide-tolerant, along with 71 percent of cotton and 61 percent of corn" (HBS Case 9-510-025 (2010)). Insect-resistant (Bt gene) maize "…was planted on 63% of U.S. corn acreage in 2009 while *Bt* cotton use grew to 65%. In India in 2009, 5.6 million small farmers planted *Bt* cotton on 8.4 million hectares (87% of India's total cotton, up from 80% in 2008). Six EU countries planted *Bt* maize in 2009" (HBS (2010)).

This relatively wide-spread use was not arrived at smoothly: a growing controversy over GMOs led to Monsanto's abandonment of efforts to introduce GM wheat in 2004; only in July 2009 did Monsanto announce that it was restarting wheat research with its purchase of WestBred LLC, a seed germplasm company. Our purpose here is not to pass judgment on GMOs, but rather to examine whether there are after-the-fact lessons to be learned from the stop-start marketing rollout, especially insofar as it is instructive for "green innovation" in general – that the term "green innovation" applied to GMOs may be considered an oxymoron by opponents of GMOs makes the point that GMOs had a rocky start. Indeed, the opposition is in face of the fact that modern agriculture has itself historically involved considerable intervention in nature; indeed it results in "…the largest alteration of Earth's surface from its natural state that humans have achieved" (William Ruddiman, cited by Brand (2008, p. 19)).[11]

Increasingly GM crops are used as inputs for foodstuffs like corn syrup, cereals, and vegetables that end up directly on the dinner table, albeit without any labeling as to the presence of those GM inputs, as discussed below. End-consumer resistance to GM foods, particularly in Europe and at the Canadian Wheat Board, grew to become a major factor in Monsanto's 2004 decision to delay the introduction of GM wheat seeds. What are the reasons?

First, it is always possible that Monsanto's experience was somewhat case-specific: for example, it had been the chemical company associated in most Americans' minds with Agent Orange and PCBs, and it had been in the midst of various scientific disputes over safety tests of its then-just-introduced bovine growth hormone "rBGH." Moreover, Monsanto was simultaneously in the process of transforming itself from the chemical company of the past to a "life sciences" company: Robin (2010) provides a critical look at Monsanto, while a University of Virginia case study (Darden (2009) and a Harvard Business School case study (2010) explain Monsanto's history and business transformation. "Ploughing new ground" with its business and introducing newly developed GM seeds would likely have been a challenge for any company (competitors included DuPont, Ciba-Geigy, and Syngenta, none of which were being so substantially transformed). Brand (2008, pp. 147-148) is quite direct: "…the company [Monsanto] under CEO Robert Shapiro in the 1980s, moved too fast, thoroughly botched the introduction of GE crops in Europe, and was secretive when it should have been transparent" (Emphasis added).

Second, it is possible that the reaction to GM crops is in part a reaction to "agri-business": Michael Pollen (2006), and earlier Masanobu Fukuoka in Japan, have linked intensive agriculture to both unhealthy diets and harmful effects on the environment that are decidedly "unnatural": "The price paid for [the] … industrial supply of cheap meat has been a population of the obese and the chronically diabetic, waddling along, stuffed with the chicken nuggets and burgers that are the ultimate product of this relentless corn-chain. There was a time when the cornfield was the emblem of American wholesomeness. Now, as Pollan describes, it seems more like the mortuary of American nature…though 'one part of Michael Pollan is in awe at what agribusiness has achieved: the delivery of low-cost food on an unprecedented scale.'" [12] Perhaps the last sentence here best poses the question: the agricultural industry has risen to the challenge of feeding the hungry masses, but has the mispricing of its carbon footprint, subsidies (e.g. for corn), and poor marketing resulted in a less-than-optimal outcome?

Third, new GM foodstuffs fall into my categories above of non-transparent, high risk products to the end-consumer. The high risk in consumer perceptions occurs because foodstuffs are ingested directly, and any unknown effects on health could be non-reversible – unlike say an electric automobile where the technology is more transparent (an electric vehicle has the same body strength and crash-worthiness of conventional ICE autos) and reversible (the car can be disposed of in the event of big problems, or more likely, the manufacturer can offer a warranty against unforeseen problems as part of the product and concomitant promotion). Another example is innovation in electricity generation; for example scrubbing coal is green tech, but the method of generating electrons is not transparent to the end-user plugging an appliance into the wall outlet: "electrons are electrons." Consistent with this high risk-nontransparent categorization for GMOs, it was the staple wheat where genetic modification has perhaps had the roughest experience.

In response, Monsanto appears to have placed most of its GMO marketing emphasis on regulatory approval; indeed, so much so that claims of deceptive advertising were lodged against Monsanto alleging that its advertising suggested regulatory approval had been granted in twenty countries including the U.K. while, in fact, some of the applications were still pending (Robin (2010, p. 199). Having regulatory "underwriting" play a linchpin role in marketing might seem a priori reasonable in case of introduction of a new technology such as GMOs, i.e. it is potentially an informationally-efficient way to economize on the costs of establishing and communicating the safety of a new and non-transparent technology to a wide-range of potential users, particularly end-consumers (ignoring the contention of some, e.g. Milton Friedman, that the US Food and Drug Administration (FDA) had a poor track record on food and drug safety). The FDA's recent (March 3, 2010) warning to manufacturers concerning the health and nutrition claims on labels of processed goods sold in the U.S. "…about the number and variety of label claims that may not help consumers distinguish healthy food choices from less healthy ones and, indeed, may be false or misleading" is an example of its regulatory intent to inform those consumers.

Especially in hindsight, Monsanto clearly made strategic marketing errors in appealing to regulatory approval as the way it handled lack of transparency. Unfortunately, the GMO substances were deemed by the FDA to be "…substantially similar to substances commonly found in food such as proteins, fats, and oils, and carbohydrates." As such, FDA did not require testing of the GMOs as food additives like preservatives and coloring agents. Indeed, many

have pointed out that some legerdemain was required here: Monsanto had to effectively argue that gene insertion did not constitute an additive to the plant DNA, while at the same time arguing that the modified plant constituted "new life" for the purposes of patent applications. The upshot of the regulatory "relief" in the FDA approval process was that the GMOs did not have to be labeled as such; indeed, such products could not legally be labeled as such given FDA's ruling that GM plants are substantially equivalent to existing conventional substances. The testing on GMOs was then left up to the manufacturer like Monsanto itself, with summary test results provided to FDA. The absence of FDA testing must have weakened the marketing value of the regulatory approval, or at least complicated the marketing challenge in ways that were not fully addressed. Fennell（2009）, in reviewing biotech companies' communications concerning genetically engineered crops during the 2001 – 2003 timeframe, argued that the general-education marketing campaign was simply ill-conceived: "… in the case of the biotechnology companies, they claim to be everything to everyone. Through the form of their texts, companies aim to simultaneously present truths in a depersonalized way, educate consumers, and brand their company names. Consumers paradoxically are considered to have valuable perspectives for the companies to consider yet need to be taught by the companies."

On the other hand, what critics see as Monsanto's close control of test data could equally well be construed as protection of new technology – the technology here being particularly difficult to protect since it is an implementation（of biotech）that required time-consuming and crucial development. Green technology is, of course, no different from biotech in general in this respect. As if to attest to this similarity, questions have recently been raised about outsourcing and independence of FDA testing in the pharmaceutical drug approval process in general, e.g. Barlett and Steele（2011）. A complicating factor is that GMOs like Bt-corn and Bt-potatoes（"New Leaf"）are regulated by the EPA rather than the FDA, since the genetic modification is to make these crops produce their own B-t pesticide. Of course, for all the GMOs where the "secret sauce" is the implementation, ipso facto the expertise lies with the developer – in the extreme, testing may be virtually impossible without substantial developer input; to a critic, the participation of the developed /manufacturer in the approval process appears to be industry capture of the regulator, while from the opposite perspective, the process is one of sharing of technical know-how.

Whatever the business reasons for the approach that was taken to allow Monsanto to do the toxicity testing in the process of regulatory approval and to not label GM foods, it

unambiguously prevented Monsanto from targeting its marketing to the consumer segment that is most responsive to global warming solutions. That is, since the GM products were not labeled, the end-consumer had no way to identify, and identify with, the GM food. Perhaps such a group of "environmentally conscious" end-consumers was judged too small to matter in the mid-1990s, although by 2010 it is clearly segmented out by companies as diverse as Toyota, General Motors, General Electric, and Walmart. The environmental message for GM crops could seemingly have been used as part of a compelling message: "…soil holds more carbon in it than all living vegetation and the atmosphere put together…plowed land is the source of gigatons of carbon dioxide in the atmosphere" (Brand, 2008, p. 135). Monsanto may also not have found it efficient to build a brand with GM foods at the retail level, since the GM inputs are far enough back in the food chain that they become ubiquitous in retail products. In this respect, they differ from, say, a genetically engineered salmon fish that turns up directly on the dinner plate, as discussed below.

Given the lack of specificity of the GM-based retail product to brand with Monsanto's name, it appears to have turned to "public-at-large" education concerning the environmental benefits. For example, the slogan "Food, Health, Hope" was widely used in advertisements in the 1990s; Robert Shapiro, Monsanto's CEO spoke of "…trying to invent some new businesses around the concept of environmental sustainability" in a 1997 Harvard Business Review interview; and in 2009 Monsanto was named Company of the Year by Forbes and its current CEO Hugh Grant was named one of the world's best-performing CEOs in the Harvard Business Review.

With a less-than-optimal marketing program aimed at general public acceptance at the retail level rather than at specific end-customer segments, Monsanto's immediate customers in the supply chain were seed-dealers and farmers who are several steps removed from the end-consumer. One contentious element in Monsanto's business strategy that seems to have complicated marketing efforts to farmers was the licensing rather than outright sale of seeds to farms: Under the same 1980 "patenting of life" legal decision that led to the controversial patenting of the human genome, Monsanto required buyers to sign a technology use agreement for its GMO seeds. Under this license agreement, purchasers of its seeds cannot re-sow those seeds. This shift in the legal framework for supplying the seeds well illustrates the likely complexities of translating the optimistic "innovation [that] will help solve the global warming problem" into day-to-day business – as the technology changes, the rules of

ownership of intellectual property and patent rights can be expected to change as well; indeed, it is rewards to that intellectual property that are needed to stimulate the innovation in the Romer analysis of the economics of innovation. The food chain situation was summed up by Michael Pollan back in 1998: "Most of the intelligence and local knowledge needed to run ［a farmer's］farm resides in the head of ［the farmer]. Growing potatoes conventionally requires intelligence, too, but a large portion of it resides in laboratories in distant places like St. Louis ［Monsanto's headquarters], where it is employed in developing sophisticated chemical inputs. That sort of centralization of agriculture is unlikely to be reversed…" Not only was well-understood economics of intellectual property and pricing highly pertinent to the marketing program for GMOs, but the shifts in ownership of knowledge are occurring across the technology spectrum: for example, Internet intermediaries are able to collect and "mine" a considerable amount of information that traditionally was considered private, just as a farmer's decision to re-plant seeds would have been considered "private" in the old regime.

It is interesting that an equally nontransparent biotechnology behind say a new diet pill could also pose high risk to the end-consumer. In the case of a diet pill, which is often heavily branded, a medical doctor who prescribes the pill can be regarded as a source of end-consumer assurance. Perhaps that is why, as Brand（2008）points out, "…about a quarter of all new drugs are made by genetic engineering –137 so far in the United States, 87 in Europe…we put these substances into our bodies without a second thought"（p. 133）. Still, potential end-consumer resistance to new health products that are ingested has occurred in the past, e. g. when vaccinations were first introduced in the 19th century; perhaps the early resistance to vaccinations can be explained by the contamination in vaccines that occurred in the early stages, while no adverse effects from GM foodstuffs have been documented to date.[13] Reasoning along these lines, perhaps it is certification *per se* of organic farmers, as much as certification of the organic produce, that matters most – interestingly, GM crops are not accepted as organic and so are excluded from that certification process. If so, then further "centralization" of farming into large companies which can establish a certification and brand is indeed likely.

Branding has been successfully applied to foods that are familiar. Indeed Chiquita has been so successful in branding bananas – arguably as homogeneous as potatoes -- that Chiquita has reportedly had difficulty in "extending" its corporate brand name beyond bananas. Further, marketing and branding for the end-consumer should not stop at the supermarket given that

an estimated 40% of food is consumed outside the home. This induces an interesting mixture of branding, e.g. a three Michelin star restaurant has its own branding, and its menu items might in turn reference name-branded providers, e.g. a ranch where the meat was raised（which is in turn perhaps vertically integrated with the slaughterhouse as a quality assurance mechanism, etc.), and this name-branded ranch might in turn be situated in a name-branded location. Along the same lines, the "molecular gastronomy" movement that stresses the science of food ingredients and cooking（and hence one would think consumers to be fully capable of understanding the technology of genetic engineering）has been increasingly associated with well-known chefs such as Jose Andres in Washington D.C. and the recognized – "highly-acclaimed" brand -- restaurant *Bazarre* in Los Angeles. Presumably the social-activity aspect, the shared emotional experience, of restaurant eating is a critical component of high-end restaurant branding.

Supermarkets（and in Japan, department store food basements）are a major part of the customer-facing equivalent of the restaurant for home food preparation, with their own branding efforts: "'The politicization of food is one of the major issues going forward,' ［CEO］ Price says…'Waitrose has been historically well-positioned to reassure customers that these things are really important to us – we own a farm and the foundation in Africa – and we are not doing it for short-term benefits but because it is the right thing to do. I think our customers are aware…that Waitrose cares for those things."[14] Whole Foods, the U.S. specialty supermarket that has branded itself as a supplier of organic and "natural" foods, explicitly avoids foods with genetically engineered ingredients that are by law deemed non-organic. But interestingly Whole Foods Web-site announces that they "…also encourage other manufacturers and producers to create products without genetically engineered ingredients or processes and to label them as such," and that Whole Foods "…established a partnership with the Non-GMO Project." In short, the supermarkets that have taken an interest in educating their customers about food ingredients seem to have taken the stance of educating them <u>against</u> genetically engineered ingredients!

"The main element that distinguishes Europe from America and other parts of the world in regard to GE crops is the seriousness with which Europeans take what is called the precautionary principle"（Brand, 2008, p. 160). As defined by Wikipedia, "the precautionary principle states that if an action or policy has a suspected risk of causing harm to the public or to the environment, in the absence of scientific consensus that the action or policy is harmful,

the burden of proof that it is *not* harmful falls on those taking the action." The precautionary principle is as controversial as it is vague. It is purportedly a risk concept. There are two generally acknowledged elements of risk: one is a circumstance in which there are so many "unknown unknowns" that it is well nigh impossible to estimate probabilities（often referred to as "uncertainty" following Knight). Part of the negative reaction to Monsanto's genetically engineered seeds might have been concern about unknown unknowns – the "fifth P" of a marketing program that was discussed in Section 2. That is, if consumers feel that they have "no handle" on the technology and probabilities of outcomes, on average they can be expected to display what would appear as extreme risk aversion. The decisions of consumers in these circumstances will be observationally equivalent to those of a consumer who does feel that they understand the risk but have a very high coefficient of risk aversion; the "tyranny of choice"[15] and/or resistance to change, costs of information-gathering, etc. just reinforce the risk aversion.

The second risk situation is that where the probabilities of outcomes are understood. In this case, decision-makers can make risk-return trade-offs. The "return" for the segment of socially-responsible consumers is their utility from doing what they consider socially responsible given their preferences; part of that "return" may be the social or networking rewards of belonging to a group of like-minded individuals, e.g. environmentalists who bought the very first Prius model. It seems unlikely that Monsanto's marketing slogan "Food, Health, Hope" helped much in leveraging a specialized environmentally-aware segment as first movers. Michael Pollan, one of the most widely-known food experts and a potential product ambassador, concluded in 1998, when thinking about eating the "…bag of biotech spuds [potatoes] on my porch…what I like best about these particular biotech potatoes…is that I have this choice. And until I know more, I choose not." That is, marketing hasn't shown the benefit to being the guinea pig. Worse, it is a random bet as to whether one is the guinea pig (since the product is not labeled). To make the point with a contrasting example, compare biotech spuds with the following "message"（note --not called an "advertisement"!）to end-consumers for Carmen's Fine Foods, a Melbourne Australia supplier of packaged premium foods: "…Carman's products are free from any artificial colours, flavours, preservatives, palm oil and genetically modified ingredients. Carman's founder, Carolyn Creswell says "We see the Food Service trade as a great opportunity to get people to sample our products. We have worked with Qantas since 2003 and have attracted so many loyal customers who went on to buy our muesli products after trying them on a Qantas flight." Not only are these "premium" foods branded as being free from ingredients anchored by negative-association words like

"artificial ingredients," their ingredients are held out as carrying an implicit endorsement by a significant end-consumer brand in itself, Qantas, *qua* a "restaurant in the sky." Which message – Carmen's or Monsanto's -- is more compelling?

A well-developed marketing program for genetically-resistant crops like Bt-vegetables would stress that the alternative is a crop covered in pesticides. This would be particularly relevant to crops that are often not peeled (e.g. strawberries or tomatoes), where there is a risk that pesticides were not sprayed evenly. That is, include a "perfect is the enemy of the good" contrast between GMOs and alternatives.

Political affiliation may also be an attribute by which to segment end-consumers in the marketing for GM foods: Brand (2008, p. 148) poses the rhetorical question: "why was fluoridation rejected by the political right and Frankenfood [GE foods] by the political left? The answer…is that fluoridation came from government and genetically engineered crops from corporations. If the origins had been reversed – as they could have been – the position would have been reversed too." [Emphasis added] This contention is not water-tight: as noted earlier, early U.S. vaccination programs were in fact carried out by governmental bodies, but faced substantial resistance (but possibly the information flow to political affiliates now versus the 19th century invalidates the analogy). Moreover, we can contrast Monsanto's experience with that of Brazil's Embrapa (Empresa Brasileira de Pesquisa Agropecuaria), also a public company, described in the Economist (August 28, 2010): Embrapa "…does everything from breeding new seeds and cattle, to creating ultra-thin edible wrapping paper for foodstuffs that changes color when the food goes off [turns rotten], to running a nanotechnology laboratory creating biodegradable ultra-strong fabrics and wound dressings…. Brazil has also been importing genetically modified soya seeds and is now the world's second-largest user of GM after the United States. This year Embrapa won approval for its first GM seed." Perhaps Embrapa, with a strong existing reputation, was able to introduce genetically engineered products with more credibility (i.e. to more customers with more loyalty to Embrapa's technology know-how) than did Monsanto?

Is any of Monsanto's GMO marketing experience-to-date relevant to the current efforts of the small Waltham Massachusetts company named AquaBounty to grow and distribute a salmon fish that has been genetically engineered to grow quickly? Aqua Bounty is currently in the midst of obtaining U.S. Food and Drug Administration approval. Farmed salmon is itself not

new（nor were the crops for which GE seeds were developed）: farmed salmon was introduced in Norway in 1971, and currently accounts for three times the amount of wild salmon harvested. The benefit is along the same lines as for GE foods: farmed salmon, which has been bred to grow twice as quickly as wild salmon with half the food, has the potential to improve yields, as in the promise of genetically engineered foods -- while the latter reduces the exhaustion of natural resources and GHG emissions, farmed salmon reduces the exhaustion of wild – natural -- salmon resources.

Interestingly, AquaBounty is pursuing Monsanto's course in arguing that GE salmon shouldn't be required to be labeled. If it were labeled, should AquaBounty, qua "manufacturer", establish a brand? Or would labeled GE salmon sold by a trusted retail brand be a better solution? First, Ishida and Fukushige（2010）present evidence that, in Japan, branding mackerel with respect to the supply harbor cooperative creates brand equity. That is, there is some evidence for the potential for a "manufacturer" to brand fish. Presumably part of the brand equity for the mackerel is because the brands differentiate better taste and/or better freshness. Second, Kenning et al.（2009）also provide survey evidence that wholesale branding reduces end-buyers' costs of verifying quality and prices of home-improvement products. On the other hand, wholesale branding may be more straightforward for home improvement goods（for example in the U.S., Black and Decker, Stanley）or in Japan for mackerel where the brand carries information about location of the catch, than for genetically engineered foods with end-consumer lack of transparency and uncertainty about the product.

Approaching the branding question from the side of a prospective retail partner, Esbjerg et. al.（2004）study retailer brand architecture, defined as the assortment（portfolio）of retailer branding, manufacturer branding, and generic products offered at retail outlets. In particular, they compared the relative emphasis of manufacturer branding versus retail branding across European food retailers. They found, for example, that: "British supermarket retailers are widely regarded as being at the forefront of retailer branding and are acknowledged as a source of inspiration by other retailers, who mimic British food retailers through direct and indirect imitation"（p. 29）. That is, if a retail food partner were sought by Aqua Bounty as part of a marketing program, that partner should most resemble the British retailer（as compared to other European retailers – one might speculate that the Japanese food retailers with food basements do closely match the British food retailers）.

One observation from Japan suggests that the correct marketing program is not an either-or choice between retail branding and manufacturer branding, but rather a combination that maximizes the customer's feeling of transparency and emotional kinship with the product: In a recent *Japan Times* story about the Hills Marche farmers market in Tokyo: "…the number of participating vendors and visitors…has increased steadily and business is going well...'One problem with the industry is that prices are determined based on market quotations and market standards alone. Taste doesn't figure in the evaluation, so consumers are likely to choose produce based on things like shape,' Miyaji explains. 'Another problem,' he continues, 'is that the producer's name is frequently removed from the product. Therefore, producers can never receive positive feedback directly from the consumers, so they get no sense of satisfaction from their work'." The issues of transparency and branding are both present in the interviewee's words – in the earlier discussion here, the value of branding equates most closely to the "satisfaction from［the farmers'］work."

Aqua Bounty has both advantages and disadvantages in marketing the genetically engineered salmon as compared to Monsanto in marketing its genetically modified seeds. As to the advantages, Monsanto and Aqua Bounty arguably don't start at the same point: genetically engineered food ingredients are now better known and understood than when Monsanto first introduced its transgenic seeds in the 1990s; perhaps the relative Embrapa success is testimony to a "familiarity effect." An additional Aqua Bounty advantage is that North Atlantic wild salmon is basically no longer an alternative. Farmed non-transgenic salmon is. But there is currently a negative connotation to farmed salmon. This negative could possibly be leveraged into the branding and marketing message: the alternative to transgenic salmon will typically not be wild "organic" salmon, but farmed salmon, something that could be differentiated as an inferior alternative. Aqua Bounty, which also farms its salmon, may be able to differentiate itself as using less-disease-prone than "regular"（farmed）salmon techniques. Labeling would be required! But then why stop at labeling? In the spirit of marketing in the new information age, discussed earlier, why not place Web cameras in the Aqua Bounty plant -- display "how the sausage is made", add educational facts that enhance transparency, etc. Indeed, it would be relatively inexpensive to connect flat screen monitors at the point of sale for Aqua Bounty, enhancing the immediacy of the customer experience as well as the transparency, the latter reducing the customer's perceived risk.

AquaBounty may face some disadvantage relative to Monsanto in the latter's introduction

of transgenic seeds insofar as Aqua Bounty is a small specialized company while Monsanto is a larger established company with existing brands. On the other hand, perhaps Monsanto's branding with end-consumers was arguably problematic before it began, given Agent Orange and PCBs. On the risk side, the large company would in principle be putting more on the line in reputation and exposure to lawsuits in the event of unknown allergic and toxic effects -- in this respect, it is one more irony that various GE-opponents rail against Monsanto's power and intentions as "a large company."

5. Summary and Discussion

I have discussed here the role that corporate and product marketing and branding seem to be playing in "filling the holes" in GHG emissions pricing schemes. The basic idea is that, done right, branding and marketing programs create trust and loyalty between segments of end-consumers and producers in the supply chain that create disincentives for the latter to exploit emissions assessment imperfections for "regulatory arbitrage profit" so long as a segment of the end-consumer has some environmental awareness.

I also developed a list of attributes for green products and services that are important in marketing and brand-building for new green tech products and services, and analyzed how these attributes would have been useful in marketing for Monsanto's roll-out of genetically modified seeds. The same basic attributes apply to Aqua Bounty's current efforts to introduce a genetically modified salmon into the U.S. marketplace.

It might be argued that proposing that a company like Monsanto would act more responsibly than it otherwise would for corporate risk control reasons is almost as foolhardy as arguing that say Lehman was acting responsibly in financial risk control prior to September 2008! Indeed, there are *a priori* similarities in the Monsanto and Lehman cases: the "relaxed" regulatory regime at the time of Monsanto's introduction of GM seeds bears some resemblance to the deregulation of the financial industry that many would contend was partly responsible for the financial crisis: in both cases, emphasis on testing and risk management was increasingly placed on "self-monitoring" by respective industry members which held the expertise; in both cases new technology was involved – in the case of banking, the financial technology that enabled the securitization of mortgages and creation of collateralized claims on these securitized bundles of mortgages, and in Monsanto's case, new techniques for inserting

genes into plant cells; in both cases, the size of the dominant industry players increased and concomitantly the potential network or systemic risk – in the form of "too big to fail" financial institutions in the financial sector, and in the case of GM seeds, in the alleged "network" spread of the GM seeds that have become mixed in with traditional seeds for virtually all respective crops.

On the other hand, one difference, in principle at least, between the financial sector and the agricultural sector, is that risk-taking incentives of "too large to fail" financial institutions are accentuated by explicit or implicit government insurance. Monsanto, and other potential suppliers of green technology, technically bear their own risk, although perhaps not under duress given the strength of the agricultural lobby in the U.S., Japan, Australia, Europe, and most other developed countries. Monsanto detractors at the least delight in assigning its decisions and risks to Monsanto's own shareholders and debt holders.

I have not yet considered the cost of equity and debt financing of the firm that is likely interwoven with its sustainability practices and marketing strategies. There is little systematic evidence that socially responsible shareholder initiatives in the past (for example, the apartheid-free portfolio restrictions in the 1970s) had a significant impact on companies' equity capital costs. Recently, however, "…banking analysts and others suggest that heated debate over climate change, water quality and other environmental considerations is forcing lenders to take a much harder – and often uncomfortable – look at where they extend credit, and to whom…most major banks have developed environmental risk management divisions as part of their commercial banking due diligence efforts."[16] The presence of the environmental risk management groups inside banks suggests that if, as here, sustainable business practices and branding constitute a mechanism by which to mitigate business risk, then banks are developing the expertise to take it into account in assessing default risk. As noted earlier, the realized impact of product recalls on the "asset cash flow side" does seem to be ameliorated by socially responsible corporate programs, e. g. Minor (2010). I have also not considered corporate governance and management incentives. Baron (2006) analyzes conditions under which managers pursue socially desirable objectives that are consistent with management compensation contracts that are chosen by shareholders. More expansively, corporate mergers and acquisitions, such as Monsanto's continuing purchases of businesses as part of its transformation to a "life sciences" company approved by its own shareholder Board, presumably partly reflect confidence in its attempted marketing and distribution strategies.

Finally, although I believe that marketing incentives discussed here help explain why a large number of companies are embracing sustainability, and thus helping "fill in" regulatory gaps, I end on note of not claiming too much: The pragmatic 80-20 rule, which is just an informal version of a power law distribution, would here suggest that 20% of sources will be responsible for 80% of GHG emissions. [17] Indeed, it turns out that in the U.S., 35% of GHG emissions in 2008 were due to electricity generation; 27% to transportation（passenger cars 33%, light trucks and SUVs 29%, freight trucks 21%, commercial aircraft 7%); and 19% to industry（EPA（2010)). Agriculture is responsible for 7% of emissions. That is, approximately 80% of the emissions are coming from three broad sources – electricity generation, transportation, and industrial. Marketing programs like those discussed here are unfortunately not likely to provide incentives to the electricity generators to reduce emissions and/or adapt to climate change. The reason is simple: the distributor and the end-consumer typically get their electricity from a grid, and it is impossible to cut back any one producer within that grid framework: to take the easiest example, an environmentally conscious end-consumer who would be willing to pay a premium for "clean energy" has no way of paying the environmentally clean producer on the grid. Equally important, electric utility rates are regulated, and new plants require Utility Commission permits – including for small nuclear plants which many observers see as the most environmentally responsible alternative.

Notes

1）Professor-in-Residence, San Francisco State University.

2）The term "carbon" is used throughout the text here as shorthand for carbon-equivalent（CO2e）emissions. Calculators and conversion tables for computing carbon-equivalent emissions are readily available on-line, e.g. at the U.S. EPA site.

3）Note that the much-debated Jevons problem in improving energy efficiency – that higher energy efficiency encourages more use of emitting-producing devices that potentially "use up" the energy saving -- is no problem with perfect internalization of the costs of polluting: If the lower-per-unit emissions of the higher efficiency device result in more units of usage, the social cost of that extra usage is accurately taken into account.

4）For example, property rights as to initial emissions are difficult to nail down: a polluting plant that was slated for retirement can suddenly become a windfall "regulatory arbitrage" carbon credit upon introduction of the scheme. Moreover, contexts change: e.g. the internal combustion engine（ICE) automobile was hailed as the answer to pollution (in that case, horse manure in the streets) when it was introduced; one hundred years later, electric drive-trains are being hailed as the answer to ICE pollution and inefficiency.

5）For example, Finance 101 texts often point out that it might be optimal for a business to hold onto

inefficient old equipment when technology uncertainty exists, since by so-doing the business gains an option to replace the old equipment in the future with better-than-current technology.

6）*Financial Times*, "This is just the early stage," Saturday/Sunday December 4-5, 2010, Life & Arts section.

7）Financial Times, August 28/29 2010, Weekend Life & Arts section, p. 19.

8）Another example of leveraging: "PepsiCo's 'good for you' products are better for you than the 'better for you' part of the portfolio, which is, in turn, healthier than the 'fun for you' part of PepsiCo's business…" (*New Yorker*, May 16, 2011, p. 56).

9）One might argue that it is not just the Web: Increasing urbanization may in the longer run be equally important to the YouTube / Facebook network immediacy in re-shaping marketing, if only because the physical proximity itself enhances social interaction among customers. In general, urbanization is likely in turn to lead to predictable changes like increased mobility, diversity, innovativeness, education, greater connectivity and early adopter consumers, and a greater range of diversity in leisure versus work times, lighting at nights. Presumably these changes will offer additional opportunities for segmenting consumers, along with new technology and changes in the desired mix of products, e.g. additional demand for financing for education.

10）*New York Times*, Business Section, Sunday August 29, 2010, p. 6. It seems likely that the buyers also want some assurance that the green tech cars will work – branding will presumably play an equally important role where the green car technology is not transparent: "Ominously for Porsche, the premium buyers said they would be more likely to buy an electric car made by Toyota, Daimler, or BMW than one made by Porsche or VW, probably because the other companies already have hundreds of low-emission prototypes on the roads."

11）The carbon footprint of "natural" farming is sometimes easy to forget. For example, Paul Romer, writing optimistically about technology promoting growth, here bio-growth: "…imagine[s] the ideal chemical refinery. It would convert abundant, renewable resources into a product that humans value. It would be smaller than a car, mobile so that it could search out its own inputs, capable of maintaining the temperature necessary for its reactions within narrow bounds, and able to automatically heal most system failures. It would build replicas of itself for use after it wears out, and it would do all of this with little human supervision. All we would have to do is get it to stay still periodically so that we could hook up some pipes and drain off the final product. This refinery already exists. It is the milk cow. And if nature can produce this structured collection of hydrogen, carbon, and miscellaneous other atoms by meandering along one particular evolutionary path of trial and error (albeit one that took hundreds of millions of years), there must be an unimaginably large number of valuable structures and recipes for combining atoms that we have yet to discover." Alas, there is a complication, which Nicholas Stern, mentioned above, points out: "Direct emissions of methane from cows and pigs is a significant source of greenhouse gases. Methane is 23 times more powerful than carbon dioxide as a global warming gas."

12）"Lunch with the FT," *Financial Times*, June 12, 2010, Arts & Leisure, p. 3.

13）For example, in their survey, perhaps even more significant because it is European, Batista and

Oliveira（2009）"…presented several scientific studies that have been performed with the aim of addressing and clarifying the issues of safety of GE foods. From these, it is clear that there is no unequivocal evidence supporting adverse effects of any of the currently commercialized GM food products. Based on scientific data, the European Food Safety Authority（EFSA）has been providing recommendations on transgenic plants and their products that EU countries should follow"（p. 284）.

14）"Lunch with the FT: Middle England's shopkeeper," Financial Times, June 19/20 2010, p. 3.

15）The "tyranny of choice" is well expressed by a London Sunday Times writer's comment on the Tesco push for carbon labeling: "Those of us who have only recently begun paying attention to the fat, sugar and salt content of foods or contemplating the fair-trade option are being asked to grapple with a whole new statistic: the grams of carbon dioxide emitted throughout the life of a product — from field to shelf to plate to bin."

16）*New York Times*, "Lenders Back Off Environmental Risks," August 30, 2010.

17）There is the danger that if attention is focused just on the 20% of sources responsible for 80% of emission problems, the 21st percentage source of emissions could grow substantially!

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