Introduction: the path to sustainability

The path to sustainability has not necessarily been paved with gold, though many hoped it would be.[1] They discussed the wins available for society and wins available for businesses. The wins would be new ways of eliminating waste and introducing novel products with unique features customers would value. They viewed sustainable innovation as a sound business proposition and challenged businesses to take this road not only because it was in the vital interests of society but because it was a sound business proposition. If businesses were going to fulfill their moral obligation to society and simultaneously pursue their obligations to their financial backers and other constituencies, then they had to engage in sustainable innovation. Since the articulation of this idea more than 20 years ago, many businesses have taken up this call in whole or in part. Very few have entirely resisted it. Whether their efforts were completely sincere was the topic of Frances Bowen's book *After Greenwashing*.[2]

The aim of this book is to examine the experiences particular businesses have had with sustainable innovation during this period in order to assess and learn from these experiences and more importantly to consider the challenges that lie ahead. One element appears not to have been taken sufficiently seriously by the many previous champions of sustainable innovation. That element was risk and the importance of strategic choice in an environment of uncertainty. Like innovation of any kind, sustainable innovation has been a bet on the future. With respect to the future, humans – no matter how keen or shrewd – have limited forecasting capabilities. Their decision making is guided by passion and gut instinct as much as it is by rational calculations, and they make mistakes no matter how well intentioned they may be.

The readers of this book will become acquainted with many bold efforts by heroic and pioneering individuals to change the world for the better, but also will witness the results of many errors in the pursuit of sustainable innovation from which they can learn. After more than

20 years of attempts to achieve sustainable innovation in various organizations, it is now apparent that plans go awry, results often are more unintended than intended, unexpected contingencies arise, and that the individuals involved must re-examine the paths they have taken and try to reset them to better accommodate new realities. Even the most sophisticated technologies, the best business models, and the leadership of powerful, inspiring, energetic, and frequently highly capable individuals do not always lead to what bestselling authors Esty and Winston have referred to as "green gold."[3]

In the language of David Vogel, the "market for virtue," while not non-existent, in many cases is narrow and limited.[4] To hit that bull's eye, where sustainable innovation is possible on a wide-scale basis and is not just a tiny niche, is a formidable task. A brutal sorting out process of what works and what does not work has taken place. Government policies, because of the uncertainties inherent in them and the inadvertent side effects they trigger, as Vogel points out and this book shows, have played a substantial role in both nudging the process forward and blocking progress.[5] Neither markets by themselves nor markets assisted by governments, as a consequence, have been entirely up to the task of securing a future in which the planet, people, and profits flourish and in which the environment is protected, equity and social justice are secured, and economic growth and development maintained.

This book consists of 20 open-ended, inter-related cases that deal with the ongoing challenge of achieving sustainable innovation in some of the world's largest and most prominent organizations. The cases in this book are open-ended because the issues they raise about the sustainable journeys of these business organizations are not over, not by a long shot. These organizations are in the midst of deciding what to do next. The reader of this book is invited to take part in this process. What are the ensuing journeys these organizations should take to achieve their sustainable goals and the sustainable goals of society? The cases deal with two of sustainability's main concerns – fueling and feeding a hungry planet – and are meant for discussion and debate by managers, would-be managers, researchers, consultants, activists, government officials, public policy analysts, and students about the routes these organizations should take next. Based on their past actions and achievements, how should these organizations adjust their goals and take the concrete managerial steps that will better enable them

to fulfill their obligations to their stakeholders and their financial backers?

The following are among the questions that these organizations face and with which this book should help its readers grapple:

- Which sustainable options are the most promising for investors, and at which stage – early or late – should investors back them?
- Which business models should organizations use to move innovations toward broad commercialization?
- Which factors in the macroenvironment and the industry context facilitate or impede their forward momentum?
- Where will they find large enough markets for broad adoption?
- How will competitive battles among different types of organizations – mission and non-mission based – influence the results?

The investment question is covered by an in-depth analysis of the choices of the two largest private equity venture capital (VC) backers of clean energy, Khosla Ventures and KPCB, and by an in-depth analysis of the investment choices of the two largest corporate VC backers of this type of innovation, Intel Capital and Google Ventures. The business model question is covered by an analysis of the contrasting business models of two of the largest solar power startups, First Solar and Suntech, and by analysis of the contrasting business models of the two most significant electric vehicle startups, Tesla and Better Place. The macroenvironment and industry context question is raised for innovators in hybrid car technologies, Toyota and GM, and innovators in wind power generation, Vestas and General Electric.

At this point the book turns from fuel to food. The question of finding markets large enough for the adoption of sustainable products focuses on the experiences of the ready-to-eat cereal companies General Mills and Kellogg's and on the experiences of the beverage and snack companies Pepsi and Coca-Cola. The question of competition between mission and non-mission based companies has as its focus Whole Foods and Walmart, and DuPont and Monsanto.

Each question is covered by two cases and each case features two organizations dealing with a similar issue. The case studies in the book are inter-related in that together they tell a single story based on extended examples of organizations trying to cope with dual challenges of fuel and food. They are on the path to sustainability but the market for virtue is an imperfect guide.

The reader should be aware of the global dimensions of the strategic business choices organizations trying to make sustainable innovations confront, and pay special attention to the interplay of public policies in different countries, how they affect business competition, and how they influence outcomes. From reading this book, the reader should gain a sense of what might come next on the road to sustainable change. In 30 years' time, the world may be in serious trouble or it may have adequately transformed itself to deal reasonably well with the ongoing conundrums that fuel and food pose to people and the planet.

An evolutionary journey

An evolutionary model of the innovation journey informs the selection of the cases in this book.[6] The journey described is evolutionary in the sense that there are a wide variety of firms in competition with each other as well as in competition with incumbents. The lock-in of incumbents' business models and technologies provides barriers to innovative shifts in direction. Among new entrants, there is a high degree of churning. Many disappear quickly. To challenge incumbents' power, new entrants need protected spaces. If they survive, their growth often exceeds that of incumbents. The innovation journey can end in incremental adjustment with incumbents surviving as well as discontinuities that destroy incumbents' distinctive competencies.

The evolutionary perspective holds that a fitness "landscape" chooses the survivors.[7] It functions as a sorting mechanism that tests what works and what does not. Only some organizations have business designs that will become dominant. For a new design to become dominant a series of bottlenecks have to be overcome. Whether they can be surmounted is subject to substantial uncertainty. Even if in the end, particular business models and technological paradigms dominate over others, early stages are characterized by many entrants and relatively low dominance levels.

In an initial exploratory or embryonic stage, variation takes place. Uncertainty is high, many firms enter. Experimentation is rife. Competition is intense. Startups compete with mature firms. Selection is subject to shifting conditions. Business models have to adjust and change as they confront new challenges. Mature firms are at risk but so are the startups. Many startups do not survive. Retention may take a long

time before a stable sorting of the winners and losers takes place and there is greater stability.

The evolutionary perspective relies on the concepts of variation, selection, and retention. Variation, selection, and retention act like a funnel. Ultimately, stabilization may happen, with convergence around particular models and technological paradigms, with some business models surviving and others being discarded, but this moment is far from inevitable.

Relying on an evolutionary approach, I divide the cases in this book into these stages (see Table 0.1): (1) variation, (2) selection's onset, (3) selection, (4) retention's onset, and (5) retention. Each stage is covered with two paired cases. The main activities in stages 1 and 2 are funding and business model testing. In stages 3 and 4 they are coping with shifts in external conditions and finding new customers. In stage 5 they are moving sustainable innovations to the mainstream.

Stage 1 involves numerous startups experimenting with concepts. Stage 2 comprises startups trying to refine their business models and establish them on a firmer footing. The next stages involve mature and early-stage companies confronting novel challenges and seeking new customers. In the final stage, mission-based firms face off against non-mission based firms for dominance. As sustainable innovation moves to the mainstream, few firms survive the first stage. Some firms succeed beyond expectation in the next stage, but in the following stages they confront new problems and challenges. For incumbents, the question is whether to exploit what they have been doing best, or explore for new sustainable options. At later stages they have to assess whether sustainable innovation has become the norm. If so, to what extent must they conform to it?

The economic exploitation and introduction of innovations into widespread use varies. Some innovations take a very long time to diffuse. Others never diffuse. Because winners and losers in the competition are determined by ex-post selection, the journey to sustainable innovation is not subject to rational planning.

The current understanding of the evolution of innovation is skeptical of the inevitability of optimal outcomes.[8] In the end, the fitness landscape determines which organizations succeed and which organizations fail, but the fitness landscape is far from perfect. The spread of inferior business models and technologies can take place because selection is not just a result of intrinsic goodness. Chance and timing

Table 0.1 *Sustainable innovation: evolutionary stages*

Stage	Main activity	Players and goals	Principal outcomeses	Chapters	Ca
1. Variation	Funding	Numerous startups experimenting with many concepts	Very few firms survive, many fail completely	1–2	Cl
2. Selection's onset	Business model testing	Early-stage companies trying to build their businesses	Firms struggle, some continue on, some succeed beyond expectation, and some fail	3–4	Pu
3. Selection	Coping with macroenvi-ronment and industry shifts	Mature and early-stage companies competing in established markets	Firms discover new obstacles to their initial successes	5–6	Hy

4. Retention's onset	Finding new customers	Mature companies trying to renew themselves	Firms choose between declining products and sustainable options	7–8	Ac
5. Retention	Moving sustainable innovation to the mainstream	Non-mission based generalists facing off against mission-based specialists	Firms decide between more or less convergence	9–10	Al

influence the outcomes, as do political and institutional biases. Innovations gain significant footholds even when they are not as efficient as the alternatives.

Embodying persistent feedback and learning, the evolutionary journey is not linear. Rather it is best understood as an emergent process that unfolds as a series of trials and errors. The prior knowledge that is needed to guarantee optimal outcomes simply does not exist. Knowledge expands from experience during the journey and affects organizational survival.

Upon reflecting on the chapters that follow, readers should judge for themselves. To what extent has the path to sustainable innovation been affected by mistake-ridden learning?[9] To what extent has it been subject to imperfect selection?

Notes

1 M. Porter and C. van der Linde, "Toward a new conception of the environment–competitiveness relationship," *Journal of Economic Perspectives* (1995): 97–118; M. Porter and C. van der Linde, "Green and competitive,"*Harvard Business Review* (1995): 120–34; S. Hart, "A natural resource based view of the firm," *Academy of Management Review* (1995): 986–1014; P. Shrivastava, "The role of corporations in achieving ecological sustainability," *Academy of Management Review* (1995): 936–60; K. Sexton, A. Marcus, K. Easter, and T. Burkhardt, *Better Environmental Decisions* (Washington, DC: Island Press, 1999); F. Reinhardt, *Down to Earth* (Boston, MA: Harvard Business School Press. 2000); S. Sharma and M. Starik, *Research in Corporate Sustainability* (Northampton, MA: Edward Elgar, 2002); W. Stead, J. Stead, and M. Starik, *Sustainable Strategic Management* (Armonk, NY: M. E. Sharpe, 2003); S. Sharma and J. A. Aragón-Correa, *Corporate Environmental Strategy and Competitive Advantage* (Northampton, MA: Edgar Elgar, 2005); D. Esty and A. Winston, *Green to Gold: How Smart Companies Use Environmental Strategy to Innovate, Create Value, and Build Competitive Advantage* (New Haven, CT: Yale University Press, 2006); P. Senge, B. Smith, N. Kruschwitz, J. Laur, and S. Schley, *The Necessary Revolution: How Individuals and Organizations are Working Together to Create a Sustainable World* (New York: Random House, 2008); P. Hawken, A. Lovins, and L. H. Lovins, *Natural Capitalism: Creating the Next Industrial Revolution* (New York: Little, Brown, and Company,2008); S. Sharma, M. Starik, and B. Husted, *Organizations and the Sustainability Mosaic* (Northampton, MA: Edgar Elgar, 2008);

A. Werbach, *Strategy for Sustainability* (Boston, MA: Harvard Business School Press, 2009); R. Orsato, *Sustainable Strategies: When Does it Pay to be Green* (New York: Palgrave Macmillan, 2009); S. Hart, *Capitalism at the Crossroads: Next Generation Business Strategies for a Post-crisis World* (Upper Saddle River, NJ: Pearson-Prentice Hall, 2010); M. Russo, *Companies on a Mission* (Palo Alto, CA: Stanford University Press, 2011); C. Laszlo and N. Zhexembayeva, *Embedded Sustainability: the Next Big Competitive Advantage* (Palo Alto, CA: Stanford Business Books, 2011); M. Blowfield, *Business and Sustainability* (Oxford, UK: Oxford University Press, 2013).

2 F. Bowen, *After Greenwashing* (Cambridge, UK: Cambridge University Press, 2014).
3 Esty and Winston, *Green to Gold*.
4 D. Vogel, *The Market for Virtue* (Washington, DC: Brookings Institution Press, 2006).
5 *Ibid.*
6 H. Aldrich, *Organizations Evolving* (Thousand Oaks, CA: Sage, 1999).
7 G. Dosi and R. Nelson, "Technical change and industrial dynamics as evolutionary processes," in B. H. Hall and N. Rosenberg (ed.) *Handbook of the Economics of Innovation, Vol. 2* (North-Holland, 2010), pp. 51–127.
8 *Ibid.*
9 *Ibid.*

1 *Leaders of the pack: Khosla Ventures and KPCB*

Khosla Ventures and Kleiner Perkins Caufield & Byers (KPCB) were the leading venture capital (VC) investors in clean energy. They had to assess what they would do next. To what extent did the clean energy sector continue to be attractive? To what extent should they continue to invest in it? If they continued to invest, which categories should they emphasize? At what stage in the maturation of a startup should they concentrate their investments?

Clean energy consisted of energy efficiency, solar, alternative modes of transportation and energy storage, biofuels, and wind and agricultural technologies that had the potential to reduce reliance on fossil fuels such as coal and oil.These sustainable technologies had the potential to reduce noxious emissions, lower the chances of climate change, and decrease dependence on a commodity imported from unstable regions of the globe. They also might be able to build new industries and create jobs. The US Department of Energy (DOE) projected that the US and world economies would continue to be largely dependent on fossil fuels into the foreseeable future.[1] Clean energy's use expanded under the DOE's business-as-usual scenario, but its impact was not transformative. This forecast, however, could change, if clean energy made a series, or even single, major leap forward. Venture capitalists (VCs) might partially or fully fund a disruptive movement in the way energy was produced and consumed that was similar in impacts to the revolution that took place when the Internet took off. Since startups with game-changing technologies rarely had the money they needed to finance their growth and development, they often depended on VC funding.

Venture capitalists were general partners in the investment funds they created. As of May 2014, Khosla Ventures had created five investment funds and had raised $2.3 billion since its inception in 2004, while KPCB, had created twenty-nine investment funds and raised $7.4 billion since its inception in 1972. Venture capitalists like Khosla