Bitcoin Energy Usage

Did you ever think someone – not a nation state – could create a new currency? This would be a private currency and these have existed in the past – usually created by a bank (Orcutt, 2019). In the 1830s in the US, 90 percent of the money took the form of private banknotes. Exchange rates fluctuated wildly for many of these banknotes because of the changing trust banknote holders had in the issuing bank’s ability to buy back the banknotes.

Rumors would frequently fuel exchange-rate chaos. Not surprisingly, frustration came to many holding such banknotes. National currencies with a national banking system stabilized things because people imparted credibility to the issuing institution. (Although countries prone to

(Continued)
printing money, such as Venezuela, have experienced sudden declines in the exchange rate of the Venezuelan currency relative to the Euro of 30 percent in 2012 and 40 percent in 2016 (XE, 2020). Digital currency is alluring to some in the era of the internet. In the coming years, groups of countries might issue their own digital currency (Winck, 2020). In the meantime, a private currency has emerged in recent years called Bitcoin which is based on blockchain technology.

Blockchain is a distributed ledger system for use on the internet (Reiff, 2020). It allows all the parties to a transaction to verify that the transaction occurred as proposed by the parties. The cryptographic structure of blockchain ensures that tampering with the transaction history will be detected immediately by other network participants.

Bitcoin is an open system in which anyone in the network can participate without permission, so that payments can be sent, stored and received. Bitcoin serves as the universal unit of value within the Bitcoin peer-to-peer network. For Bitcoin, the blockchain acts as a complete record of every Bitcoin transaction ever made (Baraniuk, 2020).

Bitcoins are issued according to a predictable schedule on average every ten minutes through a process called mining. In such mining, computers are connected to the network to verify transactions. Such verification involves solving puzzles (similar to identifying a randomly selected number) (McCarthy, 2019). Some miners employ warehouses full of computers in pursuit of the Bitcoin rewards. Bitcoin is a volatile currency and has hit an all-time high of $20,000 per Bitcoin but went to half that value in a matter of weeks (Bambrough, 2020). One Bitcoin miner reported that the costs to mine 1 BTC is around $8,200 for his operation (Young, 2020). The primary costs for a Bitcoin miner comes from electricity used to run computers used in mining (CBECI, 2020).

Although Bitcoin mining remains a very private undertaking cloaked in secrecy, recent estimates of the amount of energy directed around the world to Bitcoin mining is around 64 TerraWattHours (TWh) of electricity (Vincent, 2019). This is more electrical energy than the entire country of Switzerland consumes in a year (58 TWh). Annualized Bitcoin electricity consumption grew by about 20 percent from 2018 to 2020 (CBECI, 2020).

Defenders of Bitcoin say that the carbon footprint is what should be the focus – not electricity consumption (implying that Bitcoin mining conducted in Iceland which has abundant geothermal power to generate electricity would result in little greenhouse gas emissions into the earth’s atmosphere) (Baraniuk, 2019). Defenders also note that the always-on but inactive electronic devices in the US could power the Bitcoin network four times each year (Vincent, 2019).
CHAPTER OVERVIEW AND LEARNING OBJECTIVES

This chapter will highlight some of the most important topics in sustainable business practices – especially those related to new ventures led by entrepreneurs. Environmentally oriented businesses sometimes spark controversy because of (a) their involvement in political action and (b) the potential of other worthy social causes being eclipsed by the attention environmental issues might receive from the media and in public discourse.

A set of contributing factors to the recent turn by some firms toward sustainability can be understood by considering the context in which business is now conducted. Specifically, social, technological, and resource changes comprise the ‘STaR’ elements of the context for business and must now be considered (Werbach, 2009). A brief examination of what fuels environmentally oriented firms – consumers purchasing ‘green’ brands – will give insight into the possible future of such firms.

Firm responses to the environmental imperative are diverse. As sustainability consultant Darren Duber-Smith notes, no firm has ever attained 100 percent sustainable status (Duber-Smith, 2009). A ‘cradle-to-cradle’ approach to turn waste for firms into food for other entities is at the core of architect William McDonough’s emphasis on reusing and recycling to be more environmentally effective. As a consultant, McDonough and his partner Michael Braungart have developed the McDonough-Braungart Protocol to assist firms such as the Ford Motor Company and furniture-maker Herman Miller to improve the environmental stewardship of their operations. The McDonough-Braungart Protocol represents one way for firms to self-regulate themselves. Voluntary compliance to internationally respected standards is one avenue for firms to pursue self-regulation. The International Standards Organization based in Switzerland offers an ISO 14001 certification program for environmental management similar to the quality standards in manufacturing, such as ISO 9000, or the most recently developed standards for social responsibility – ISO 26000 (see Chapter 4). Other approaches include CERES, and the Natural Step (Mager and Sibilia, 2010).

Questions to Consider

- What are your thoughts about Bitcoin’s intensive energy consumption?
- Would the world be better off without a currency that can be used outside of the banking and credit card system?
- Would you exchange an amount of currency from the US, Europe, Australia or China that is equal to your living expenses for the next year in order to invest it in Bitcoin?
- Currently, speculative investors are those buying Bitcoin. Is it better for society that their money goes into such speculation about a virtual currency?
As part of self-regulation, metrics for environmental stewardship are important for environmentally oriented firms. The carbon footprint is one metric that enables firms to gauge their contribution to increasing the amount of carbon in the atmosphere—a key factor in global climate change. Such metrics often lead firms to realize that their supply chain accounts for a major portion of the carbon footprint for their products and services. The elusive pursuit of carbon neutrality raises questions about how carbon neutral a firm can become.

Any product, service, or process that delivers value using limited or zero nonrenewable resources and/or creates significantly less waste than conventional offerings can be classified as ‘clean tech’. Three main sectors of clean tech include (a) transportation, (b) water, and (c) energy. Examples of ventures from each of these sectors will be featured in this chapter’s Mavericks Who Made It. This chapter concludes with not one but four Mavericks in Markets to illustrate how four types of market imperfections hold opportunities for entrepreneurs to create profit-making solutions for environmental problems (Cohen and Winn, 2007, p. 31). These market imperfections to which ventures can be targeted follow: (a) inefficient systems, (b) externalities, (c) flawed pricing mechanisms, and (d) imperfectly distributed information.

After this chapter, you should be able to answer the following questions:

- What are the four stages of entrepreneurship?
- What is sustainable entrepreneurship?
- What is ISO 14001? CERES? The Natural Step?
- What is the LOHAS segment of consumers?
- What is ‘cradle-to-cradle’ design or the ‘circular economy’?
- What is clean tech? What are the different types of clean tech?

Mia Birk – an innovator in city government and later in the private sector

UNDERSTANDING SUSTAINABLE ENTREPRENEURSHIP
From Intrapreneur to Entrepreneur

Entrepreneurs are those who provide a new product or service working for themselves in the private sector. Intrapreneurs work inside firms or governments and promote innovative product development and marketing through employee-entrepreneurial activity (Peterson, 2020). Both develop and use new ways to produce or deliver existing goods and services at a lower cost: ‘Entrepreneurs innovate. Innovation is the specific instrument of entrepreneurship’ (Drucker, 1985, p. 30). The effect of innovation is the creative destruction (old forms of business being made obsolete by new forms) cited by the twentieth-century economist Joseph Schumpeter who celebrated the entrepreneur. Sustainable entrepreneurship is the process through which individuals and teams create value by focusing on the well-being of the natural environment and communities in the pursuit of opportunities (Shepherd and Patzelt, 2011).

The bicycle and pedestrian movement gaining momentum now has developed over many years through the sometimes patient and sometimes daring efforts of bicycle activists, city planners, policy makers, and bicycle commuters in thousands of communities around the world. Mia Birk (pictured opposite) became one of the most high-profile leaders of this movement as manager of Portland, Oregon’s bicycle program, and later as President and Co-Owner of Alta Planning + Design based in Portland, Oregon. She now heads Mia Birk Consulting, which does professional coaching and business consulting (Birk, 2020).

Birk obtained a bachelor’s degree in government and French from the University of Texas at Austin. When she went from her suburban home in Dallas to continue her studies in Washington, DC, car parking loomed as a problem. Her brother gave her his ten-speed bicycle to use. Despite being a self-described ‘couch potato’ at the time, she used his bicycle and liked the by-products of bicycle commuting. She lost weight and felt better.

‘Within a few weeks, I was in the best shape of my life, and a lifelong love affair had begun,’ Birk said. ‘Since then, I have been a dedicated bicyclist for recreation, touring, exercise, and daily utilitarian trips. I have two children – ages 13 and 9 and see bicycling as a win-win strategy for maintaining my family’s health, safety, budget, and community connection’ (Szczepanski, 2010, p. 1).

In 1988, Birk began as a grad student emphasizing international-environmental-studies at Johns Hopkins University. She studied transportation and ‘how where we live affects how we get around’ (Moon, 2010, p. 1).

She realized that the bicycle offered a win–win proposition to relieve congestion in cities of the world, reduce air pollution, and reduce obesity for individuals. Birk was in Washington, DC, in 1991 when a federal transportation bill first included funding for trails, bike lanes, and sidewalks. Because she was working with a coalition focused on energy conservation, she became aware that jobs would soon be available in the bicycle and pedestrian field (Moon, 2010).
Birk’s credibility in the bicycle and pedestrian movement originated from her accomplishments as a public sector worker in Portland from 1993 to 1999 during the city’s rise to become the top bicycling city in the United States (Moon, 2010). During this time, Birk served as Portland’s bicycle program manager.

‘People think Portlanders just drank some microbrew one night and started riding bikes in the morning,’ Birk said. ‘Not the case at all’ (Dundas, 2011, p. 11). The truth is that, despite some forward-looking funding for beginning bike trails as a reaction to the 1973 Arab Oil Embargo, Birk often endured bitter public meetings and resistance in Portland. Portland’s culture and transportation system, like many other US cities, focused on the automobile. But Birk proved skillful in creating change inside the system of city government, regional planning organizations, citizen groups, and businesses (Dundas, 2011, p. 11).

Early in her time as Portland’s bike program manager, she mobilized citizen support that led to the city council adopting a bikeway-network plan. She later helped this plan come into reality by navigating endless challenges and problems. Along the way, she had to overcome antiquated traffic engineering standards, fight federal regulators, explain her actions to the skeptical journalists of The Oregonian newspaper, cajole reluctant city maintenance workers to sweep glass in bike lanes and fix dangerous drainage grates, and push along colored bike lanes, bike bridges, and a trail along the Willamette River (Birk and Kurmanskie, 2010). ‘There are political battles behind every single piece of infrastructure that exists,’ Birk said. ‘To succeed in that arena, you have to build teams’ (Dundas, 2011, p. 12). Since 2008, Bicycling magazine has rated Portland as one of the ‘best cities for cycling,’ placing it in the top five cities (Maus, 2018).

Mia Birk’s story highlights important aspects of taking an entrepreneurial orientation. First, entrepreneurship does not begin with a product or service but with an opportunity that is rooted in the external environment (Morris, 1998). From her work in promoting energy conservation policy in Washington, DC, she recognized that the federal transportation legislation’s inclusion of funding for bicycle and pedestrian travel would create many opportunities for transforming urban landscapes into communities aggressive about including such travel in their transportation systems. She took the opportunity to go to Portland as the city’s bicycle program manager recognizing that Oregon was forward-thinking in developing alternatives to automobile travel. Oregon was already using a portion of the state budget to improve roadways for bicycle travel. This illustrates how the opportunity – public funding of bicycle and pedestrian transportation infrastructure – existed in the external environment outside of any one firm.

Then, over a period of six years in the 1990s, Birk provided community-wide leadership to change the culture of Portland to be more bicycle friendly (Mapes, 2009). Importantly, she learned what it took to win approval for infrastructure improvements for alternative means of transportation so that many constituencies were pleased with the outcome. This illustrates how entrepreneurs are not born, but they develop over time through learning.
When Michael Jones contacted her after she had left her position with the city government, she was ready to join him by opening the Portland office of his new firm. In this way, she would develop the opportunities for planning and designing bicycle and pedestrian transportation into the plans of cities across the United States and beyond. In 2009, Birk and Jones spun off Alta Bicycle Share, Inc., which successfully launched and operated the bike-sharing systems in Melbourne, Washington, D.C., Boston, Chicago, and New York City, among others. She also co-founded a professional association (Association of Pedestrian and Bicycle Professionals), an academic program (Initiative for Bicycle and Pedestrian Innovation), and a coalition of cities that developed a fresh approach to urban bikeway design (NACTO Urban Bikeway Design Guide).

In all of its bike-sharing programs, Alta Bicycle Share partnered with Public Bike Share Corporation (PBSC) of Montreal, which provided the bicycles and kiosks with solar-powered docking stations, theft-resistant locking devices, and credit-card processing technology (Coster, 2011). Lyft acquired Alta Bicycle Share in 2014 and Birk stepped away from Alta Planning + Design the next year (Maus, 2015).

Birk recalled that when she joined Alta it had about a dozen projects worth about $100,000. In 2015 when she left, Alta had about 400 active projects, 20 offices, and $25 million in annual revenue.

‘At the beginning, people would ask me, “What is that you do again?”’ Birk said. ‘Portland had its bike plan, but that was about it. Nationwide, there wasn’t even a field for bicycle transportation consulting services. I had to create the language around what I did.’
Stages of Entrepreneurship

Entrepreneurship does not only occur at a particular point in time. Rather, a dynamic process of entrepreneurship takes time to unfold (Morris, 1998). Across identifiable stages, the entrepreneurship process can be managed. Results of research suggest that the process of entrepreneurship can be characterized by four phases (see Table 10.1): (a) searching, (b) planning, (c) marshaling, and (d) implementing (McGee et al., 2009).

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<thead>
<tr>
<th>Table 10.1</th>
<th>Stages of entrepreneurship</th>
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<td>Searching – developing a unique idea or identifying a special opportunity.</td>
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<td>Planning – converting the idea/opportunity into a workable business plan.</td>
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<td>Marshaling – assembling resources to bring the venture into existence.</td>
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<td>Implementing – growing the business.</td>
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Source: McGee et al. (2009).

The searching phase involves the development by the entrepreneur of a unique idea and/or identification of a special opportunity. This phase draws on the entrepreneur's creative talents and the ability to innovate. Entrepreneurs, as compared with managers, are particularly adept at perceiving and exploiting opportunities before these opportunities are recognized by others (Hisrich and Peters, 1998). Birk and her colleagues were not the first company to field a bike-sharing program. In Washington, DC, Clear Channel Communications, provider of advertisements and signage at subway and bus stops, launched SmartBike in 2008 (Martinez, 2010). However, marketing problems plagued SmartBike. Without enough bikes and bike stations and too little promotion, SmartBike never fared well. Its pricing was only targeted to commuters with an annual $40 subscription fee. Tourists had no cheaper option. However, Capital Bikeshare, launched by Alta Bicycle Share, had more bikes and plenty of promotion.

The planning phase consists of activities by which the entrepreneur converts the idea into a workable business plan (McGee et al., 2009). Here, the entrepreneur may or may not actually write a formal business plan. However, he or she must evaluate the idea or business concept and give it meaning as a business. The plan addresses questions such as: What is the size of the market? Where will the business establishment be located? What are the product specifications? How and by whom will the product be manufactured? What are the start-up costs? What are the recurring operating costs of doing business? Will the venture be able to make a profit, and if so, how soon after founding? How rapidly will the business grow, and what resources are required to sustain its growth?

The marshaling phase involves assembling resources to bring the venture into existence (McGee et al., 2009). At the end of the planning phase, the business is only ‘on paper’ or in
the mind of the entrepreneur. To bring the business into existence, the entrepreneur gathers (marshals) necessary resources such as capital, labor, customers, and suppliers without which the venture cannot exist or sustain itself.

Capital Bikeshare is based on a public–private partnership with capital expenditures for kiosks and bicycles provided by public funding, while user fees covering the operations run by private companies, such as Alta Bicycle Share (Martinez, 2010). The city retains any advertising revenue at the kiosks or on the bicycles. Additionally, the city controls the colors of the bicycles (Whitford, 2011).

The final phase is implementing (McGee et al., 2009). The entrepreneur is responsible for growing the business and sustaining the business past its infancy. To this end, the successful entrepreneur applies good management skills and principles. As an executive-level manager, the entrepreneur engages in strategic planning and manages a variety of business relationships with suppliers, customers, employees, and providers of capital. Growing an enterprise requires vision and the ability to solve problems quickly and efficiently. Not unique to entrepreneurship, these tasks are also required of effective managers. However, the entrepreneur is the primary risk-bearer of the enterprise with a financial stake in its long-term growth and success.

Operational risk for launching a bike-sharing program emerges from having the venture’s property stolen or damaged. Alta Bicycle Share knows that the moment bikes and stations are established, they will be challenged by thieves or vandals. ‘The first thing people do – mostly teenagers – is try to steal the bikes. They’ll jerk them up and down and side to side,’ Alta Bicycle Share CEO Alison Cohen said. ‘In Montreal they have a picture of a Ford F-150 with a rope connected to a bike, but the truck couldn’t get the bike out of the dock. With a system that’s secure like that, theft and vandalism are very minimal. The only real theft we’ve seen in the US has been people using a stolen credit card to take a bike and not return it’ (Whitford, 2011, p. 1).

Entrepreneurs are calculated risk-takers (Morris, 1998). They are not wild-eyed risk takers. Research suggests that their propensity to accept risk is not very different from society at large. They will thoroughly analyze and evaluate the prospects for ventures and deals based on the risks evident for financial returns, technical success, and sufficient numbers of customers paying for their products or services.

In addition to the risk-taking inherent in pursuing innovation, entrepreneurs must bring proactivity to the implementation of the plan to bring their focal concept into a viable product or service and an ongoing business enterprise (Covin and Slevin, 1989). In other words, they must put their plan into action. This almost always requires perseverance, adaptability, and a willingness to accept some responsibility for failure of the venture (Morris, 1998).
GREEN OPPORTUNITIES FOR SUSTAINABLE ENTERPRISES

Concern for the Planet and Communities on the Rise

Opportunities always reside outside of the firm and not in product or service concepts themselves. For example, ‘better mousetraps that nobody wants’ can describe the largest category of new product failures (Morris, 1998, p. 26). In other words, a new product can be technologically sophisticated, but when it is introduced into the marketplace, its sales lag and fails. Such failure could occur because (a) customers are already satisfied, (b) the concept is too difficult to comprehend, (c) the perceived switching costs are too painful, or (d) customers simply do not have a need for such a product or service.

Concern about climate change topped the list of issues across respondents in 14 countries (US, Canada, Australia, Japan, South Korea, and EU Countries) surveyed in Spring of 2020 (Poushter and Huang, 2020). The median percentage across these countries was 70 percent for those saying they perceived global climate change as a major threat to their countries. Such concerns set the stage for firms doing more for reducing greenhouse gas emissions. Efforts such as RE100 have emerged in recent years to transition firms to 100 percent renewable energy (RE100, 2020). Hundreds of major corporations have joined RE100 and have committed to use renewable energy for their needs in the coming few years. Some of these firms are Allianz Group (German-based insurance firm), Apple, Tesco (UK-based grocery retailer), and Tata Motors (India).

Second, institutions have proposed goals, standards, and approaches to better the environment and communities. For example, the Sustainable Development Goals (SDGs) serve as a blueprint to achieve a better and more sustainable future for all (United Nations, 2020), and the UN Global Compact asks companies to support a set of core values in the areas of human rights, labor standards, the environment, and anti-corruption (these were discussed in Chapter 4). British environmentalist and social commentator John Elkington estimates that the SDGs (a set of 17 goals with 169 related targets) offers an unprecedented opportunity for businesses worth up to $12 trillion a year in just four of 60 sectors (food and agriculture, cities, energy and materials, and health and well-being) (Elkington, 2017).

Other institutions and NGOs have made contributions to raising awareness of issues related to sustainability. For example, in 2000, the US Green Building Council developed an internationally recognized certification system for the design, construction, and operation of environmentally friendly buildings called the Leadership in Energy and Environmental Design (LEED) Green Building Rating Systems™ (USGBC, 2011). Receiving one of the top LEED certifications, such as Silver, Gold, or Platinum, translates into understandable advantages for owning and maintaining these certified buildings – if for no other reasons than the reduced expense of operating them.
NGOs such as the International Standards Organization based in Geneva, Switzerland, developed a suite of standards for environmental quality management – ISO 14000 – which today is the most widely implemented environmental management system (Mager and Sibilia, 2010). ISO 14000 first asks a business to create an environmental policy. The next step is to determine the environmental impacts of all the products, services, and activities done by the firm. Then, the firm plans its environmental objectives and measurable targets. Finally, the firm implements its plan, checks it in an ongoing way, makes corrections, and engages in management review of its progress.

Similar sets of principles for environmental management include the CERES principles, which mandate that results of reports on the environmental impact of the firm be made public, and the Natural Step Framework, developed by Swedish oncologist and karate-champion Dr. Karl-Henrik Robèrt (Mager and Sibilia, 2010). The Natural Step was adopted and made popular by Interface, Inc.’s founder and CEO Ray Anderson (see Chapter 1).

The principles of the Natural Step to become a sustainable society are reducing (a) the progressive buildup of substances extracted from the Earth’s crust (such as heavy metals and fossil fuels), (b) the chemicals and compounds produced by industrial processes (dioxins, DDT, PVC), (c) the progressive physical degradation of nature and natural processes (over-harvesting of forests), and (d) conditions that undermine individuals’ capacities to their basic human needs (such as unsafe working conditions and meager wages).

In working with hundreds of companies, municipalities, academic institutions, and not-for-profit organizations all over the world, the nonprofit The Natural Step has found that sustainable decision-making does not lead to negative outcomes for firms. But, rather, adopting sustainable business practices leads to new opportunities, reduced costs, and dramatically reduced ecological and social impacts.

**Businesses Make Changes for the Natural Environment**

Consumers have watched businesses become more environmentally oriented in recent years. Walmart’s transition is still in progress, but it typifies some of the most earnest efforts to adopt sustainable business practices that will not be missed by consumers over the world.

**NASCAR**

A very visible business in the United States, NASCAR, the automobile racing organization owned by the France family, has now embraced an environmental orientation (NASCAR, 2020). NASCAR is similar to many for-profit businesses today in that it is focused on cutting
costs by recycling, conserving, and generating its own energy. Accordingly, NASCAR’s teams, track operators, and sponsors have adopted an ambitious set of green initiatives that includes planting trees to offset carbon emissions and deploying sheep to keep the infield grass short.

Drawing on the imagery of the green flag waved above the track under which the cars pass when beginning a NASCAR race, NASCAR Green is the program which NASCAR runs throughout the year with more than 15 green partners. Some of the activities for NASCAR Green include: (1) racing on a blended biofuel called Sunoco Green E15, (2) pursuing large-scale recycling efforts at race tracks that include racing oils and tires, (3) diverting food waste and to productive uses, (4) using solar power at tracks, (5) sourcing from organic farms for the menu in hospitality suites, and (6) employing more energy-efficient track sweepers. The NASCAR Tree Planting Program planted more than 500,000 trees across the country by 2020 as a carbon offset for the fuel consumed by NASCAR race vehicles.

NASCAR has also supported other projects like the installation in 2010 of 40,000 solar panels over 25 acres at Pocono Raceway in Long Pond, Pennsylvania. After spending about $15 million to build the three-megawatt solar farm, the track now saves about $500,000 a year in energy costs and has produced electricity equal to 32,000,000 gallons of gasoline.

‘We gained a lot of fans because of it,’ said Brandon Igdalsky, Pocono Raceway’s president. ‘Our generation is trying to clean up the things that our grandparents and great-grandparents did’ (Belson, 2011, para. 15).

The Roush Fenway team, a joint venture between Roush Racing and Fenway Sports Group (owners of the Boston Red Sox), builds race cars and fields race teams. It recycles 96 percent of each car it produces. It has also eliminated styrofoam cups from its operations and has bought bicycles for workers to get around its facility in North Carolina. All of these steps for NASCAR are only the beginning of a long process to clean up the sport.

‘We’re realists and we race cars that burn a fossil fuel that get four to five miles per gallon, and we can’t change that,’ said Ian Prince, the chief sustainability officer at Roush Fenway. ‘But we can change the other 99 percent of it’ (Belson, 2011, para. 23).

McDonald’s

Businesses and environmentalists have increasingly been working together. For example, McDonald’s and Greenpeace have combined efforts to avoid further destruction of the Amazon Rainforest (Langert, 2019). After initially criticizing McDonald’s in 2006 for buying chickens raised on soybeans grown on illegal farms carved out of the Amazon Rainforest in Brazil, the following year Greenpeace joined forces with McDonald’s to pressure the major soy traders in Brazil into placing an unprecedented two-year moratorium on the purchase of any soy from newly deforested areas (Butler, 2009).
Bob Langert, McDonald’s vice president of sustainability at the time, reported that the Greenpeace soy campaign initially discombobulated McDonald’s leadership. Greenpeace protesters in chicken costumes entered McDonald’s restaurants in the UK and Germany with big signs reading ‘Every bite you take out of a Chicken McNugget is a bite out of the rainforest’ (Langert, 2019, p. 172).

McDonald’s supply chain represented less than half of a percent of soy purchasing due to Brazilian soy being used in chicken feed in Europe and Asia (hence, the connection to Chicken McNuggets). At first, McDonald’s leaders wanted to reply in defense that their part of a deforestation problem in the Amazon was miniscule. ‘Internally, I countered the “small” concern head on,’ Langert said (Langert, 2016). ‘Small does not mean you sit back. Everyone’s impact is small. I was raised in a McDonald’s culture that believed we could use our convening and collaborative power to bring diverse stakeholders together.’

Greenpeace’s major target was not McDonald’s, but Cargill – a privately owned global food corporation based in Minnesota in the US that was heavily involved in soy bean production in Brazil. However, Greenpeace saw that such a private firm (although large enough to be ranked as the 15th largest corporation in the US) was invisible to consumers. Without a marketing budget the size of McDonald’s to send their message about soy farms encroaching on the Amazon forest, Greenpeace targeted McDonald’s – a global brand with close connection to consumers.

Greenpeace only expected McDonald’s to change its behavior and that other firms would eventually follow. Instead, McDonald’s supply-chain executives called together representatives of their top 15 suppliers (accounting for 80 percent of materials used by McDonald’s) and told them that McDonald’s expected them to monitor and manage their upstream suppliers. Previously, the only expectation of a McDonald’s supplier was to be responsible for their own processing facilities. This marked a pivotal sea change.

By 2016, Paolo Adario, who headed the Amazon campaign for Greenpeace of Brazil in 2006, reported the moratorium (that still is in place) proved to be a monumental success. ‘After 10 years, overall Amazon deforestation has dropped 80 percent,’ Adario said (Langert, 2016). ‘And everyone continued to make money in soy (and in beef), because they improved their profile image.’

**Tom’s of Maine**

New brands have entered the marketplace positioned as delivering sustainable benefits. For example, Tom’s of Maine entered as a manufacturer of natural-ingredients-only personal care products in 1970 (Tom’s of Maine, 2020). Tom and Kate Chappell moved from
Philadelphia where Tom worked for an insurance company to Kennebunk, Maine, in 1968. Because of their goal to simplify their lives, they sought out natural, unprocessed foods, as well as unadulterated products. As they were unable to find natural personal care products for themselves and their children, Tom and Kate decided to create and sell their own. They launched their venture with a $5,000 loan from a friend and the philosophy that their products would not harm the environment.

Over the years, the product line of Tom’s of Maine moved from nonphosphate laundry detergent to natural personal care products, such as the first natural toothpaste (1975) and deodorant (1976). Recognizing the future value of an established brand with an authentic commitment to sustainable business practices in the fast-growing natural, personal-care-products category, Colgate-Palmolive purchased 84 percent of Tom’s of Maine in 2006 for $100 million (Wohl, 2006). The Chappells hold the remaining stock in their business that now boasts 90 products that are distributed in more than 40,000 retail outlets where millions of consumers encounter them in their shopping.
'When we first started out, this brand-new idea of natural products and sustainable companies seemed a little crazy to some,' Tom Chappell said. 'In the years since, though, more and more people have begun to believe, like we do, that nature can provide many of the health benefits we need – and that companies should minimize their environmental impact while working towards positive change in our communities. Together, we’ve really started to make a difference' (Tom’s of Maine, 2020, para. 1).

Consumers Turn toward Green

Segmentation studies on US consumers in recent years have identified a Lifestyles of Health and Sustainability (LOHAS) segment that is the most interested in green products and services (Ottman, 2011). Researchers estimate that one in four consumers in the US are LOHAS consumers (41 million) who spend more than $290 billion annually in their shopping (Sung and Woo, 2019). Demographically, these consumers tend to be married, educated, middle-aged, and female. LOHAS consumers have the second highest income level, so they have the means needed to buy a variety of products and services – and perhaps paying a premium for some of these.

LOHAS consumers are active in their communities and support environmental and social causes. They are conscious stewards of the environment as evidenced by their energy and water conservation, their use of cloth shopping bags, and their advocacy for environmental causes. They will use the internet to investigate new green brands, and 71 percent of them report a willingness to boycott brands that offend their values (this is twice as high as any other segment).

Importantly, they are early adopters of green technologies, and they are vocal in recommending green products and services to friends. This means that they have an impact (positive or negative) in the diffusion of innovations for any green product of which they form an opinion. In other words, they would play the role of a valued expert on green products and services in their social network. Considering that the growing market in the United States for goods and services focused on sustainability-oriented products and services, the role of LOHAS consumers is a crucial one for brands positioning themselves as promoting sustainable living. In research conducted by the Natural Marketing Institute, other segments express varying degrees of interest in sustainable living (Ottman, 2011). However, no segment is as committed to green purchasing as the LOHAS segment.

Another set of studies found evidence that altruism – in the form of buying green products that cost more – signals one’s willingness and ability to incur costs for others’ benefit (Griskevicius, Tybur, and Van den Bergh, 2010). These results suggest that such altruism is a ‘costly signal’ associated with status. In other words, in addition to signaling that a person...
is prosocial (doing things for others), altruism can demonstrate that one has the resources (time, energy, money, relationships, or other) and the ability to incur the costs of self-sacrifice for public welfare. Interestingly, eliciting status motives for respondents increased the desire for green products when shopping in public (but not private) and when green products cost more (but not less) than nongreen products.

It seems that the key question about green consumption is ‘how rapidly is it being adopted by consumers around the world?’ Studies have now identified LOHAS consumer segments of substantial size in many countries of the world (LOHAS, 2020). With Walmart’s decision to promote green products, green consumption will likely become part of mainstream consumption in the future. With the accountability mechanisms of the Web and social media in the twenty-first century, which firms want to be known for providing products and services that are more harmful to the natural environment and communities?

**Businesses Turn toward Green**

**Using Nature’s Principles**

Naturalists define sustainability as the capacity of healthy ecosystems to continue functioning indefinitely (Unruh, 2008). One can perceive the idea of ecosystem sustainability in the United Nations’ Bruntland Commission report as the commission defined sustainable development as meeting the needs of the present without compromising the ability of future generations to meet their own needs’ (World Commission on Environment and Development, 1987). Because of the usefulness of the sustainability framework for improving the efficiency and effectiveness of businesses and society, further consideration of how nature can inform approaches to human activities is warranted.

In recent years, researchers and thinkers have investigated how the principles of nature and Earth’s complex and self-regulating biosphere can be applied to the operations of businesses (Unruh, 2008). In nature, cycles characterize living organisms and ecosystems. Dead animals and plants become food for other animals and plants. Using a life-cycle approach, firms have analyzed their operations using a ‘cradle-to-grave’ approach of all steps from material extraction to disposal to understand the energy, resources, and emissions associated with the production and marketing of their brands (Ottman, 2011). An outcome of such an approach was that firms pursuing sustainable business practices emphasized ‘reduce, reuse, and recycle’ (Unruh, 2008, p. 113). However, if firms still included synthetically derived materials in their products, such as polyvinylchloride (PVC), their efforts to reduce, reuse, and recycle would remain problem-ridden for the environment. Synthetic compounds, such as PVC, are ‘monstrous hybrids’ in which biological and technical ingredients are combined in a way that makes it infeasible to separate them at the end of the product’s life (Lee and Bony, 2008).
Going beyond this ‘cradle-to-grave’ approach in which products (made of monstrous hybrids) go to a landfill after their useful life, architect William McDonough and his chemist business-partner Michael Braungart have become leading advocates for a ‘cradle-to-cradle’ approach for firms (MBDC, 2020). Such an approach illustrates the concept of a circular economy (CE) with closed material loops (Unruh, 2018). Using the McDonough Braungart Design Chemistry (MBDC) consulting firm’s cradle-to-cradle (C2C) design protocol, the concept of waste goes away. Using C2C, firms design products, packaging, and systems from the very beginning to be fully recyclable (McDonough and Braungart, 2002a). The C2C concept also designs monstrous hybrids out of products. McDonough and Braungart compared the C2C approach to traditional practice in the following way:

The characteristic design approach of the last century was ‘cradle to grave’. It involved digging up, cutting down, or burning natural resources – releasing toxic material into the environment in the process – to make products that became useless waste at the end of their useful lives. By contrast, [the] cradle-to-cradle approach mirrors nature’s regenerative cycles so that at the end of its useful life, a product and its component materials are used to make equally valuable products. C2C thinking does not just focus on minimizing toxic pollution and reducing natural resources waste. It goes one step further, demanding that companies redesign industrial processes so that they don’t generate pollution and waste in the first place. (Lee and Bony, 2008, p. 5)

Using as few raw materials as possible in the design of products mimics nature’s ways. This makes recycling easier, as using many or making a common mistake of the industrial age by including many synthetic materials in the manufacture of modern products. For example, MBDC collaborated with L’Oréal in the development of Goddess Strength Shampoo and Conditioner for its Carol’s Daughter brand (MBDC, 2020). This brand achieved the Silver level of MBDC’s program due to its (1) material health (no harmful chemicals as ingredients), (2) material reutilization (renewable and biodegradable ingredients), (3) renewable energy use (100 percent during production), (4) water stewardship (during production), and (5) social fairness (for workers and communities).

MBDC examined the composition of the Aeron desk chair made by furniture manufacturer Herman Miller based in Zeeland, Michigan, and operating in more than 40 countries (Miller, 2020). MBDC found that more than 200 components made from more than 800 chemical compounds were used in the manufacture of the Aeron. Herman Miller used the analysis conducted by MBDC to design its award-winning Mirra desk chair whose dramatically simplified set of materials allows the Mirra to be 96 percent recyclable (Unruh, 2008, p. 115). Herman Miller has more than twenty Cradle to Cradle Certified Products and each of the Herman Miller facilities around the world are powered totally by renewable energy.
Benefits from Using Nature’s Principles in Business

Architects and building developers striving to obtain LEED certification for the environmental sustainability of their buildings would use inputs such as the Cradle to Cradle Certified Product Scorecard as depicted in Figure 10.2 in choosing the materials and office furniture for their buildings. Points toward LEED certification would be gained by using environmentally certified products in a building being considered for LEED certification. Products with high ratings not only contribute to the sustainability of the building, but also make such buildings less costly to maintain. Importantly, such green buildings are more productive places for employees as a result of better indoor air quality, lighting, and toxin-free furniture. Such products can qualify for the US EPA Environmentally Preferable Purchase Program (www.epa.gov/greener-products/about-environmentally-preferable-purchasing-program). In these ways, environmental certification can give access to buyers and marketplaces where green has added value.

Figure 10.2  Herman Miller’s new Aeron chair and its Cradle To Cradle Scorecard

Source: www.c2ccertified.org/products/scorecard/new-aeron-herman-miller-inc
Firms such as office-furniture manufacturer Herman Miller have gained numerous advantages from adopting closed-loop recycling principles of nature’s ways in pursuing sustainability for their products. For example, Herman Miller has become a more flexible market player because its procurement process seeks materials that will not be regulated or restricted in the future (MBDC, 2020). Herman Miller stopped producing the paneled exterior of its iconic Eames chairs out of rosewood because it recognized rosewood was an endangered species (Michler and Fehrenbacher, 2011). By switching to walnut for the Eames chair, Herman Miller avoided a more expensive material (and one likely to be regulated or restricted in the future).

In the manufacturing process, Herman Miller gained financial benefits by avoiding employee exposure to harmful chemicals and reducing regulatory costs. In the design process, Herman Miller created a source of more readily accessible raw materials by designing products for end-of-life material recovery. It seems now that this ability to forecast the return of materials to the industry for future use will be the most significant economic gain from intelligent product design imparted by a C2C approach (McDonough and Braungart, 2002b). Finally, Herman Miller won a more defensible position in the marketplace with its products characterized by strong environmental performance. This means that Herman Miller products have higher quality because they were better designed by using the healthiest materials for users that can later be recycled into products of equal or greater value in the next cycle (upcycling).

Using recycled materials drastically reduces costs. For example, Patagonia’s Common Threads Recycling program turns last season’s Patagonia’s Capilene brand performance underwear into this season’s second-generation polyester fibers used in the manufacture of Patagonia’s clothing. It has also extended this recycling to fleece. Energy costs for making such second-generation polyester are 76 percent below those for virgin sourcing (Unruh, 2008).

Taking a cradle-to-cradle perspective for Patagonia means that the Patagonia website prominently profiles how to (a) buy and sell used Patagonia gear on eBay, (b) send in Patagonia gear for repair at a modest cost, and (c) send in gear for donation to the recycling program (Patagonia, 2020). In this way, Patagonia reinforces the idea of the durability of its products in the mind of consumers – an important reason to choose Patagonia. It also positions itself as not only a manufacturer, but also a collaborator with customers interested in reducing consumption. By taking back used products for recycling, Patagonia also assumes a role in reverse logistics – getting the product back from the user for reprocessing. This is accomplished through the mail for underwear (that it hopes is clean) and through drop-off bins at retail outlets (Unruh, 2008). In this way, Patagonia nurtures relationships with customers important to its future.
The Pathway to a More Sustainable Business

Sustainability-oriented products are increasingly part of the mainstream in marketplaces. Although many firms have not taken the leadership roles in the movement of sustainable business practices, such as Herman Miller and Patagonia, increasingly the good sense of seeking virtuous closed-loop cycles is being adopted by businesses around the world.

Among respondents who say ESG programs create value, the share seeing short- and long-term value has grown.

![Graph showing the share of respondents who say given program creates value, %](chart)

*Question was asked only of respondents who said environmental, social, and governance programs increase shareholder value. Respondents who said “substantially negative,” “negative,” or “no effect” are not shown. Total n = 484 in 2009 and n = 342 in 2019.

**Figure 10.3** Comparison of survey results (2009 and 2019) of senior leaders of firms around the globe about the value of environmental, social, and governance programs.


Figure 10.3 depicts the comparison of survey results from 2009 and 2019 of senior leaders of firms around the globe about the value of environmental, social, and governance programs. As can be seen, in the most recent survey from 2019, the clear majority of these senior leaders see these sustainability-related ESG programs as creating value in both the short term and the long term. In the long term, more than 90 percent see such value. This suggests that sustainability is not a ‘minority opinion’ across firms of the world – but a majority view among business leaders. Clearly, businesses have moved a long way toward sustainability since McDonough and Braungart first introduced cradle-to-cradle principles in the 1990s. These results also suggest that many more firms will likely intensify their move to integrate sustainability concepts into their operations in the coming years.
Clean tech refers to any product, service, or process that delivers its value by using limited or zero nonrenewable resources and/or creates much less waste than conventional offerings (Pernick and Wilder, 2007, p. 2). Opportunities for clean tech breakthroughs currently appear fruitful in (a) solar energy, (b) wind power, (c) biofuels and biomaterials, (d) green buildings, (e) personal transportation, (f) batteries for mobile power, (g) the smart grid, and (h) water filtration.

Encouragingly, clean tech energy increasingly is more affordable (Winston, 2019). With the cost of building new wind and solar facilities falling in recent years, three-quarters of coal-fired electricity-generation plants in the US are more expensive to run than new plants run by renewable energy. In April 2020, the US obtained more energy from renewables than coal for the first time in what is being called ‘the coal crossover’. Likewise, low-carbon energy has similarly overtaken coal in countries such as the UK, Sweden, Denmark, Portugal, Nicaragua, and Costa Rica.

Additionally, electric transportation is expanding. Electric vehicles (EVs) are still a small part of the car fleet, but Tesla’s Model 3 became the top-selling car in California in the first quarter of 2020 (Schmidt, 2020). China now has more than 400,000 electric buses on the road (Winston, 2019). More than 30 million in India ride electric rickshaws every day. Daimler, manufacturer of Mercedes-Benz, announced it will now direct all research and development to electric vehicles, rather than internal-combustion engines.

CONCLUSION

This chapter examined sustainable entrepreneurship. Researchers have identified a process for entrepreneurship that features four stages: (a) searching, (b) planning, (c) marshaling, and (d) implementation. Entrepreneurs come in many forms, but most are motivated by achievement—accomplishing what they set out to do (Morris, 1998). Money, while necessary to fund the venture and help grow it, often becomes more of a scorecard for intrinsically motivated entrepreneurs. Sustainable entrepreneurs create value by focusing on the well-being of the natural environment and communities in the pursuit of opportunities (Shepherd and Patzelt, 2011).

Sustainable entrepreneurs, like all entrepreneurs, are agents of change. Not surprisingly, sustainable entrepreneurs find themselves embroiled in controversy because (a) opponents of growth see them as bringing more consumption and material depletion of the Earth’s resources, (b) political action is part of what some of them do, and (c) their successes with their own causes sometimes move other causes lower in priority in public discourse.

Macromarketing scholars have noted that more consumers are changing their attitudes and lifestyles to reflect more concern for the planet and communities today (McDonagh and Prothero, 2014). This is likely a result of (a) global disruptions such as the economic meltdown of 2008 and the COVID-19 pandemic of 2020 that brought many consumers to
rethink the promises of endless economic growth, (b) the emergence of environmentally oriented media programming that reinforced nurturing attitudes toward care of the Earth, and (c) institutions that developed frameworks for activities to better the environment and communities, such as the UN’s Sustainable Development Goals, the UN Global Compact for businesses, LEED certification for buildings, ISO 14000, CERES, and the Natural Step.

To what degree consumers and businesses go ‘green’ remains to be seen. Consumers in the segment Lifestyles of Health and Sustainability (LOHAS) already represent millions who will prioritize what firms, their products, and services contribute to sustainability in their purchase decisions. Other research suggests that making green purchases can win status for consumers (Griskevicius et al., 2010). Despite such an advance for green purchasing, some consumers still interpret sustainable positioning of brands as indicative that the brands will not get the job done as well as conventional brands (Luchs et al., 2010).

Cradle-to-cradle design pursues biomimicry in applying nature’s principles to the operation of business (Unruh, 2018). Here, recycling takes a central role with the ‘waste’ of one process becoming the ‘food’ for another. Research suggests that firms typically go through five stages in integrating sustainable business practices into their operations: (a) complying with the law, (b) driving toward efficiency, (c) designing eco-friendly products, (d) developing new business models, and (e) creating next practice platforms that change existing ways of doing things (Nidumolu et al., 2009).

This chapter also considered clean tech, which refers to delivering value by using limited or zero nonrenewable resources and/or creating much less waste than conventional offerings (Pernick and Wilder, 2007, p. 2). The chapter concludes with a look at four Mavericks Who Made It. The stories of these mavericks illustrate how each addressed a market imperfection to help solve an environmental problem that became the opportunity to earn rewards in the marketplace.

QUESTIONS
• How would you compare your assessment of the viability of sustainable ventures before you read the chapter with your assessment now? What is one thing you learned that puts into perspective how a business could help solve environmental problems?
• Thinking about the sustainable entrepreneurs you encountered in the chapter, what is a theme that unifies many of the elements of their stories? Elaborate why you see this theme.
• What makes sustainable entrepreneurs distinct from conventional entrepreneurs?
• To what degree do you think sustainability is a fad? What does NASCAR’s adoption of sustainable business practices say about sustainable business practices being a fad?
• What aspect of sustainable entrepreneurship in the chapter encourages you to consider joining a sustainable venture or starting your own?
• What are some ways society could encourage and reinforce sustainable entrepreneurship?
Market imperfections have contributed to environmental degradation (Cohen and Winn, 2007, p. 35). However, these same imperfections offer rich opportunities for entrepreneurially oriented firms to develop new technologies and business models that can not only reduce environmental harm but also actually reverse the effects of environmental degradation.

Four types of market imperfections can be identified that offer sustainable entrepreneurs the chance to create profit-making solutions (Cohen and Winn, 2007, p. 31). These are (a) inefficient systems, (b) externalities, (c) flawed pricing mechanisms, and (d) imperfectly distributed information. If entrepreneurs can successfully introduce environmental innovations into the marketplace, a more sustainable future will likely develop for all.

Market Imperfection 1: Inefficient Systems – David Tse of NovoNutrients

Given the problems created by excessive carbon emissions of CO₂, what could be the impact of a new product that consumes CO₂? NovoNutrients (a venture based in Silicon Valley, California) develops protein meal through carbon capture and uses it in the rapidly growing fish and shrimp feed markets (Byrne, 2020). By changing one part of the food system into a circular economy for food, NovoNutrients minimizes waste by using it as a feedstock (NovoNutrients, 2021).

NovoNutrients’ gas fermentation process uses two inputs on a massive scale: CO₂ and hydrogen (Wright, 2020). The firm’s process uses CO₂ sourced from the untreated waste emissions from cement plants, ethanol factories, pulp and paper refineries and other industrial sources. The two gases speed the growth of the bacteria strains, which the firm calls a ‘microbial consortium.’ After fermentation, the result is a product 70 percent protein that can feed fish, pets and even people.

The key ingredient in the commercial feed used in fish farming is fishmeal, a powder made from ground-up bodies of tiny fish such as anchovies. By comparison, Novo Nutrients makes Novomeal (a nutritionally complete substitute for fishmeal) from the proteins of bacteria incubated in giant steel vessels similar to beer vats, called bioreactors.

Using its microbial process, NovoNutrients takes untreated industrial emissions of CO₂ and can turn them into protein flour. Such protein flour can form the amino acids found in meat. However, initially, the firm will target fish farming.

‘Made from specialty microbes that grow on CO₂, our product is a natural, non-GMO, complete protein with all the amino acids and without mercury or other contaminants that are found in fish flour, which is made by grinding up little, wild-caught fish,’ NovoNutrients CEO David Tse said.

(Continued)
Feed is the biggest cost of fish farming, a $232 billion global industry and it is likely to become more expensive and is subject to price volatility that can eliminate profits for fish-farming operations (Bercovici, 2019). By comparison, the supply of bacteria is unlimited for practical purposes—as long as nutrients exist to feed them.

There is no shortage of free CO₂ pouring out of factories, power plants, and automobiles. ‘The annual CO₂ emissions from a large cement plant would create 3 billion dollars of our protein flour, worth the same as the entire annual soy production of the state of Nebraska — 330 million bushels a year,’ Tse said (NovoNutrients, 2021).

With the increasing popularity of alternative proteins, such as almond milk to plant-based burgers, NovoNutrients looks forward to a day when the firm will supply the processed-food industry, too. ‘It’s more of a question of consumer preferences,’ Tse said. ‘Today, it’d be very hard to run a Super Bowl ad that convinces people that they should be eating bacterial protein.’

What firms like NovoNutrients might be constructing is nothing less than the infrastructure for an entirely new economy. This new economy will be based on producing food, energy, and material goods by sequestering harmful chemicals rather than by emitting them. In such a new economy, landfill content will result in jet fuel, and mushrooms will serve to create wood-type products using primarily renewable power. ‘What we’re doing has the potential to change not only the food system,’ Tse says, ‘but also the way other goods are manufactured.’

**Figure 10.4** NovoNutrients Uses Microbes Feeding on CO₂ to Create Protein Powder Used in Fish Farming.

*Source:* Photo by David Gabrielyan on Unsplash.
Market Imperfection 2: Externalities – Bruce Kania of Floating Island International

For the past two centuries, industrialization and population growth have served as the focus of progress in many societies (BioHaven Solutions, 2020). A cost for such progress has been the widespread contamination and destruction of wetlands and waterways. Such costs represent negative externalities because a downstream third party incurs these costs without receiving equivalent benefits as those in the original set of exchanges (Cohen and Winn, 2007). In addition to the environment and future generations experiencing degraded ecosystems, those depending on waterways for safe drinking water and for recreational opportunities in the current generation also experience this externality of development.

In 2000, inventor and outdoorsman Bruce Kania bought a farm east of Billings, Montana, near the Yellowstone River. Roaming his farmland with his dog, he experienced an externality related to water contamination resulting from modern methods of farming and ranching. Every time his black dog Rufus jumped into a pond, the dog came out red and reeked of a foul odor (Stark, 2006).

Kania soon realized that his farm was at the end of a 60-mile irrigation ditch that carried nitrogen and phosphorous from fertilizers that had run off into the ditch and been carried downstream by the water in the irrigation ditch (Stark, 2006). Too many nutrients like these in water led to too much algae. Such an overabundance of algae restricted other species upon which insects, birds, and fish depended. The result was foul water and a damaged ecosystem.

Concerned for his dog, Kania instinctively felt ‘we could do better’ and sensed a genuine opportunity for invention (Floating Island International, 2011a). Kania had become intrigued with biomimicry as a way of solving human problems using solutions modeled on nature. He asked himself whether a new and natural stewardship tool could be developed that could clean water and, in the process, save life for all the creatures who live in it. (Floating Island International, 2011b).

To answer this question, Kania brought together a team of engineers and plant specialists who turned to the floating peat bogs of Northern Wisconsin for inspiration (Floating Island International, 2011b). Kania had grown up among these floating islands, where world-record fish are to be found within crystal-clear waters. The team set about ‘biomimicking’ these floating riparian structures. By 2020, the firm has launched more than 8,000 islands around the world (BioHaven Solutions, 2020).

They created an island capable of supporting the weight of plants and soil. Layers of a flexible, matrix material made from postconsumer materials (recycled plastic drink bottles) form the floating island. Plants are then inserted into precut pockets. The matrix material serves as a cushiony batting that is porous and allows the plants’ roots to reach the water.

Figure 10.5 depicts how the floating islands clean water. Circulation carries particulates including nitrates, phosphates, and ammonia across the roots of the plants on the underside of the floating

(Continued)
water. As the plants grow, tiny microbes begin clinging to the island. These microbes take excess nutrients out of the water.

Microbes are responsible for breaking down nutrients and other water-borne pollutants, but to be effective, they need a surface to stick to. The floating island matrix, with its dense fibers and porous texture, is the perfect surface area for growing large amounts of microbes (in the form of biofilm) in a short time. Nutrients circulating in the water come into contact with these biofilms and are consumed by them, while a smaller fraction is taken up by plant roots. The team called the breakthrough technology BioHaven floating islands.

![Figure 10.5 - Floating island wetlands (FTW) process for cleaning water](https://www.floatingislandinternational.com/products/biohaven-technology/)

The unique design of these floating islands means that 250 square feet of island can clean and restore an acre’s worth of wetland surface area. In testing, 22 persons crammed onto a 250-square-foot island and stayed afloat (Stark, 2006, p. 2). These floating islands can be launched in either shallow or deep water, and they can be securely anchored or tethered to ensure that they remain in a specific location. They are almost infinitely customizable, and they can be configured in a variety of ways. Wildlife, such as waterfowl and turtles, are attracted to the floating islands.

By 2010, more than 4,000 islands had been launched by Floating Island International for cleaning not only lakes and streams but also for wastewater lagoons, farm effluent ponds, and any other waterway impacted by sewage or landfill effluent (Floating Island International, 2011b).
Floating islands are being deployed along the steel bulkheads that line the final one mile of the shipping channel of Cleveland, Ohio’s Cuyahoga River (the same one that caught fire in 1969) that runs into Lake Erie (Scott, 2011). The floating islands replicate the once green-leafy banks of the river that hosted insects upon which fish fed (Scott, 2011).

Floating Island International’s successes help one understand how externalities can become opportunities for eco-entrepreneurs oriented to solving problems in the natural environment. In the case of Floating Island International, an entrepreneurial achievement in solving smaller environmental problems can make enormous environmental challenges now seem like opportunities for the ambitious entrepreneur.

Kania envisions floating islands restoring ‘dead zones’ such as the pollution-laden mouth of the Mississippi River, or the Chesapeake Bay near Washington, DC. ‘How do you cure a dead zone?’ Kania asked. ‘One island at a time’ (Stark, 2006, p. 2). Kania also envisions floating islands that would buffer the effects of hurricanes in coastal areas, and take in excess carbon dioxide contributing to global climate change.

Market Imperfection 3: Flawed Pricing Mechanisms – Karl Ulrich and TerraPass

Conventional theories of economics assume natural resources are plentiful and that their market value accurately reflects supply and demand. Many ecosystem services (such as clean air and water, renewable energy, and a regulated climate) are undervalued or not priced at all (Cohen and Winn, 2007). A more sustainable economic system would price natural capital appropriately. Research published in *Nature* that was conducted by a team comprising ecologists, economists, and geologists from a variety of universities estimated the current value of ecological services that allow the Earth to be inhabited would be $33 trillion each year (Costanza et al., 1997). This was nearly double the combined output of the world’s nations when the study was conducted.

Renewable energy resources (solar, wind, wave, tidal, geothermal, landfill gas, and biomass sources, such as wood, fiber, ethanol, butanol, and biodiesel) are now emerging, but they struggle to be economically competitive with nonrenewable energy with its established infrastructure for extraction, processing, and distribution (and all of the cost efficiencies related to these).

Renewables have done well in states and countries (such as California and Germany) where the government has mandated quotas for renewable energy in the portfolio of energy sources. In California, the renewable portfolio standard (RPS) is set to be 60 percent by the end of 2030 (CPUC, 2020). Renewables have also thrived where the resource exists in abundance and prices for rival uses of the renewable have declined. This happened with ethanol made from sugar cane in Brazil in the first part of the twenty-first century (Orsato, 2009, p. 131). Nevertheless, about $100 billion is still needed to overhaul the distribution system as well as to improve the efficiency of the sugar mills in Brazil for global export.

(Continued)
To help renewable energy projects obtain funding, inventor and Wharton Business School Professor Karl Ulrich and his class of 41 MBA students launched a venture called TerraPass in 2004 that sells carbon offsets (TerraPass, 2020a). A carbon offset is a certificate representing the reduction of one metric ton (2,205 lbs) of carbon dioxide emissions, the principal cause of global warming (TerraPass, 2020b). Although complex in practice, carbon offsets represent a fairly simple idea. Consumers and businesses can determine how much carbon dioxide their activities generate and then pay TerraPass money to counterbalance the environmental damage they have caused. Figure 10.6 depicts this process.

![Figure 10.6](https://www.terrapass.com/about/how-carbon-offsets-work.html)

Each year, the average car emits about 10,000 lbs (three times its weight!) in carbon dioxide—a leading cause of global warming. You buy a TerraPass. TerraPass funds carbon reduction projects. Your TerraPass is thirdparty verified to reduce the equivalent of your carbon dioxide.

**Figure 10.6** How carbon offsets work

*Source: TerraPass (2020b), www.terrapass.com/about/how-carbon-offsets-work.html*

For every ton of carbon emissions reduced through renewable energy projects, one carbon offset would be created. Renewable energy project developers can then sell these offsets to finance their projects. For example, a wind farm generates clean energy, which reduces carbon emissions from coal-burning power plants. To finance its operations, a wind farm can sell these reductions in the form of carbon offsets. TerraPass, which is a for-profit company, invests in things like wind power, landfill gas reclamation, and biomass energy production.

The *New York Times* named TerraPass one of 2005’s most noteworthy ideas. Today, the company is not alone in its field with dozens of competitors – but it has excelled by packaging its product well. For example, the average individual in the US consumes in a way that 18 tons of carbon enters the atmosphere (TerraPass, 2020b). Such an individual can offset such carbon consumption for $180.

Within its first year, TerraPass registered over 2,400 members, reduced 36 million pounds of CO$_2$, and earned countless national press and blog articles. TerraPass has grown steadily (Terrapass, 2020a). The firm has a small staff in an office near the Bay Bridge in downtown San Francisco. The firm works directly with carbon reduction projects, providing revenue to dairy farms, landfill gas installations, and other projects that yield carbon credits. Importantly, TerraPass has helped individuals and businesses to reduce over 1 billion pounds of carbon dioxide.
In concrete terms, the enduring value of the work of TerraPass will likely be operating as a major player in the funding of the infrastructure for renewable energy resources that otherwise would have not made the grade as a result of conventional market pricing. Not bad for what was once an MBA course project.

‘I look around and I think we’ve had an impact,’ Ulrich said (Pompilio, 2008, para. 40).

**Market Imperfection 4: Imperfectly Distributed Information – Yoan Nussbaumer of Chargemap**

Western Europe is now the largest market for electric vehicles (EV) in the world, with sales of hybrid and plug-in vehicles exceeding China’s by 90,000 units in 2020, for a total of 1.32 million of these autos sold (Powell, 2021). In 2020, overall market share in the EU for EVs increased to 12.4 per cent.

In addition to Tesla’s EV models, Volkswagen has introduced the ID3, while Renault has introduced the Zoe and Kia has launched the Niro. A major factor in this adoption of EVs was the EU’s legislation requiring the dramatic reduction of carbon dioxide emission across a manufacturer’s fleet by the end of 2020. By December, one in four cars sold across the EU was a plug-in EV.

The infrastructure to support the charging of these EVs has proliferated in recent years. In 2020, the EU had 224,538 public charging points (Reuters, 2021).

But how does someone traveling by car in the EU find available charging stations?

![Figure 10.7](https://unsplash.com/photos/1234567890)

**Figure 10.7** Chargemap helps owners of electric vehicles find charging stations

*Source: Photo by Ralph Hutter on Unsplash.*

(Continued)
Chargemap offers a solution to the problem of imperfectly distributed information about charging stations across Europe (Chargemap, 2021). In 2009, Chargemap founder Yoann Nussbaumer was living in his hometown of Strasbourg, France and looked into buying an electric car. He could not find any.

Nussbaumer then thought of Chargemap: a tool that brings electric car drivers together in order to share information about charging points, which would help them charge their car everywhere. In 2011, with a few enthusiasts, he began to look for charging terminals and started to document them. The small team took photos of these terminals and tested the working processes.

Gradually, electric car drivers took over, thanks to the Chargemap mobile app. Chargemap now checks the information sent to them by community members before publishing this information in its map of charging stations. In effect, Chargemap is like a wiki endeavor in which users contribute to the content of the information resource—mapped locations of charging stations for EVs.

By 2021, the Chargemap community boasted more than 650,000 members who had uploaded more than 300,000 photos of different charging stations. The members share information with each other about charging experiences in order to boost the efficient use of the disaggregated network of charging stations across Europe.

A nagging problem for EV owners is being able to make payment at these charging stations. Accordingly, Chargemap developed an access and payment RFID card called the Chargemap Pass for use at charging stations. The Chargemap app identifies charging stations that accept the Chargemap Pass. There is no subscription required for the Chargemap Pass—only a reasonable commission that is taken by Chargemap on each charging session. In the future, the Chargemap app itself will allow charging.

‘Our goal is to offer electric car drivers the best charging experience in order to promote the development of these vehicles, which are less damaging to air quality,’ Nussbaumer said. ‘It’s our reason to wake up every morning, and we’re proud of it!’

Questions

• Into which of the four Mavericks in Markets ventures would you most like to make a $50,000 stock investment, if this were possible? Explain.

• Into which venture would you least like to make a $50,000 stock investment, if this were possible? Explain.

• Which venture do you believe will result in having the most positive impact on the natural environment? The least? Explain.

• Considering all the sustainable entrepreneurs featured in this chapter from Mia Birk to Yoan Nussbaumer, what role did higher education play in identifying the venture idea for these sustainable entrepreneurs? Do environmental problems targeted by sustainable entrepreneurs require more technical or intellectual skills as part of the entrepreneurs’ tool kit?
REFERENCES


