Sustainable entrepreneurship under market uncertainty: opportunities, challenges, and impact

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14. Sustainable entrepreneurship under market uncertainty: opportunities, challenges and impact

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INTRODUCTION

Scientists, policy experts, activists, NGOs and citizens have long urged nations to curb emissions to mitigate climate change—the pressing global challenge of our time that threatens humanity with disastrous and irreversible impacts. The 2015 Paris Agreement has been hailed as a vital collective achievement in strengthening the global response to climate change, with the aim to limit global temperature increase to 1.5–2°C above pre-industrial levels. Yet, having already warmed the planet by 1.1 degrees, and with emissions still rising rather than decreasing, the transformative actions that lay before us are unprecedented. Limiting global warming to 1.5 degrees by 2100 requires cutting anthropogenic carbon dioxide emissions in half by 2030 and reaching net zero by 2050 (Holz et al., 2018). If this weren't bad news enough, most countries are not even on track to reach the non-binding targets of the Paris Agreement, as a result of which the world is on a trajectory of over 3°C warming above pre-industrial levels by the end of the century (Hausfather & Peters, 2020).[2]

Despite the pressing need to turn things around quickly, existing organizations and industries are not only primary contributors of carbon emissions but also exhibit significant inertia in making the requisite changes. Governments play a crucial role in reducing emissions but broad policy mandates emanating from multiple levels of government are often vague and not localized. As incumbent companies tend to define their greening efforts in relation to business as usual (Wright & Nyberg, 2017), many look to entrepreneurs—free from existing business constraints and obligations—as being uniquely positioned to put us on a more aggressive and innovative pathway to addressing climate change (Embry, Jones & York, 2019). The idea is that entrepreneurs are well positioned to address neglected problems, with *sustainable entrepreneurship*—the process of identifying (discovering or creating) and pursuing economic opportunities consistent with pro-social and environmental objectives (Dean & McMullen, 2007; Mair & Marti, 2006)—seen as a "green panacea" (see Lenox & York, 2011; Schaefer, Corner & Kearins, 2015).

Entrepreneurial solutions to climate change, however, are complicated by the fact that sustainable markets are fraught with challenges and uncertainties that often curb entrepreneurial ventures' potential to deliver on such ambitious expectations. Consider, for example, the case of Better Place, a company that embarked in 2007 on a mission to rid personal transportation of oil by 2020. Led by the charismatic and experienced Shai Agassi, Better Place proposed a revolutionary business model around electric vehicles (EVs), positioning itself as an industry coordinator to provide batteries and a battery-swapping infrastructure for EVs. Better Place

viewed international standards as critical to the success of the EV market and attempted to persuade key market players including automakers, utility companies, charge station providers, and city governments to participate (Etzion & Struben, 2015). With a professional team, a sophisticated charging infrastructure that swapped EV batteries in just two minutes, media excitement, and $900 million dollars of venture capital, the start-up seemed destined for success. Yet after its first rollouts in 2012 in Denmark and Israel, quarterly demand for vehicles never exceeded 100, and having burned through all its cash, Better Place filed for bankruptcy in November 2013.

Another telling example of the challenges facing sustainable entrepreneurs is Q Cells, the solar cell manufacturer founded in Germany in the late 1990s. Founded at a time when solar cell manufacturing was simply viewed as an "appendix" in the portfolio of oil companies, Q Cells' founders were motivated to change the world from outside the incumbent energy system. Against the backdrop of a push for a transition to renewable energy among the German public and government alike, the new venture exceeded all expectations. The company witnessed unimaginable growth, becoming the largest solar cell manufacturer in less than a decade. But soon after, market conditions shifted. By 2011, supportive policies were reduced, which combined with concerns about the integration of renewables into the existing electricity grid and cutthroat competition from Chinese producers to end the reign of Q Cells in the solar energy business. Several European producers went bankrupt around the same time that public support waned and subsidies were being sliced or abandoned throughout the continent, considerably slowing the growth of the market. The solar energy market was not yet ready to stand on its own.

Behind these dramatic failures lie broader market dynamics that include extreme uncertainty and collective action problems inherent to sustainable enterprising. When Better Place launched, many elements necessary for a working market were missing—consumers weren't willing to consider electric driving; there was no producer supply chain that permitted efficiency, scaling, and variation in production; there were no complementary charging options with agreed-upon formats in place; and there was no effective favorable regulation. As a result, few actors committed valuable resources to this market. Better Place's inability to mobilize automobile providers and convince consumers not only doomed the early start-up, but also severely hampered the transition towards sustainable transportation, with electric vehicles currently comprising less than 0.5% of all cars on the road. In the case of Q Cells, its success relied on a stable market environment, enabled by favorable regulation—an important component of market infrastructure.[3] Public support can stimulate the market for sustainable products and public benefits can encourage favorable policy but sustainable markets that compete with incumbents for government support (e.g. public subsidies) or whose market infrastructure relies on the incumbent system (e.g. the electricity grid) are complex, risky, and take a long time to develop. It is not always clear *ex ante* if a sustainable market can become self-sufficient, and whether or when it can move from niche to mainstream.

Taken together, the above examples show that sustainable entrepreneurial ventures should not be viewed as isolated attempts to change the world. These ventures' failures were due to system-wide dynamics of collective action in their respective market spaces. Scholars have pointed out that collective action is paramount for industries to transition towards more sustainable practices (Jones et al., 2019; Pacheco, Dean & Payne, 2010; Sarasvathy & Ramesh, 2019) and that sustainable markets are particularly uncertain (Cohen & Winn, 2007; Lenox & York, 2011).[4] Yet, despite several attempts to take stock of the literature on sustainable entre-

preneurship (Johnson & Schaltegger, 2020; Muñoz & Cohen, 2018; Terán-Yépez et al., 2020), we still lack a rigorous framework for systematically incorporating the market uncertainty that entrepreneurs face across different types of markets. Given the inextricability of markets as being both the root cause of and the potential solution to sustainability challenges (Hoffman, 2018; Marquis, 2020), we draw upon recent literature on collective action during market emergence and growth (Lee, Struben & Bingham, 2018; Struben, Lee & Bingham, 2020) to map entrepreneurial opportunities and challenges across markets with varying degrees of uncertainty. In applying this framework to sustainable entrepreneurship, we not only highlight how sustainability contexts affect entrepreneurial opportunities and challenges but also attend to how and to what extent efforts under varying degrees of uncertainty may drive or inhibit societal impacts. By distinguishing between supply and demand uncertainty, we offer a framework that is rich enough to allow for systematic analysis yet simple enough to be practically useful and flexible enough to include both incremental as well as transformational changes—all of which can contribute towards a more sustainable economy and society. We elaborate on the framework below, after briefly reviewing the literature on sustainable entrepreneurship. We conclude with a discussion of future research opportunities revealed by this perspective.

LITERATURE REVIEW

Driven by the promise that entrepreneurship holds for addressing some of the world's most pressing challenges, the literature on sustainable entrepreneurship has flourished in recent years (Embry, et al., 2019; Lenox & York, 2011), and is now seen as a separate sub-field in the entrepreneurship domain (Muñoz & Cohen, 2018). Despite this surge in scholarly interest, however, there is still no consensus on the nature of the phenomenon and the definition of the central construct (Jones et al., 2019). Typical definitions of sustainable entrepreneurship indicate that it involves the pursuit of opportunities that reduce negative externalities in social or ecological environments (Muñoz & Cohen, 2018; Cohen & Winn, 2007), or the creation of positive externalities by nurturing such environments or addressing neglected social problems (Patzelt & Shepherd, 2011; Santos, 2012).

A common thread in this emerging literature is the idea that sustainable entrepreneurs seek to achieve multiple objectives by integrating economic and social or environmental goals into their ventures (Jones et al., 2019; Young & Tilley, 2006; York, O'Neil & Sarasvathy, 2016). It is not always clear if the primary objective of sustainable entrepreneurs is to achieve economic profit or social change, or even whether one objective takes priority, but the simultaneous pursuit of economic and non-economic goals is the central distinguishing feature between sustainable and conventional entrepreneurs. At the very least, there is an expectation that sustainable entrepreneurs must provide more than "just" profits and jobs; they need to contribute to social or environmental sustainability (Cohen & Winn, 2007). The balancing of multiple goals or external expectations makes sustainable entrepreneurship inherently complex. Sustainable entrepreneurs cannot merely rely on the exploitation of existing market opportunities which detract from sustainability. Rather, they need to provide more resource-efficient and innovative solutions to tackle sustainability problems that are typically "complex, dispersed, global, uncertain, interdependent and have long-term horizons" (Cohen & Winn, 2007: 46; see also Lenox & York, 2011).

Research on sustainable entrepreneurship has generated useful insights on several important questions. First, research has examined why individuals decide to engage in sustainable entrepreneurship with much of the literature focusing on attributes of the entrepreneur such as prior knowledge, identity, sustainability intention and orientation (Fauchart & Gruber, 2011; Patzelt & Shepherd, 2011; Schaltegger & Wagner, 2011). Second, studies have explored how the broader institutional environment facilitates or constrains sustainable entrepreneurship (Georgallis & Lee, 2020; Sine & Lee, 2009; Russo, 2001; York & Lenox, 2014) and how sustainable entrepreneurs foster institutions that render sustainable opportunities profitable (Arenas, Strumińska-Kutra & Landoni, 2020; Pacheco, York & Hargrave, 2014; Georgallis, Dowell & Durand, 2019). Scholars have also addressed different outcomes of sustainable entrepreneurship (Young & Tilley, 2006; Wang & Bansal, 2012). However, this work, like that in the broader corporate sustainability literature, over-emphasizes financial motivations and rewards, as evidenced by the frequent use of dependent variables that focus on the *financial* performance of sustainable ventures (see Cohen & Winn, 2007; Muñoz & Cohen, 2018). This emphasis on the 'business case for sustainability' may limit the scope of sustainable entrepreneurship to incremental win–win situations at the expense of radical changes which may require innovative thinking beyond current structures and processes. For instance, a review of why firms may be motivated to address environmental degradation concludes that there is little evidence of firms achieving revenues from environmental differentiation (Ambec and Lanoie, 2008). On the other hand, there has been a clear relationship demonstrated between the adoption of more efficient, lean processes and the reduction of pollution (King and Lenox, 2001), with perhaps the most famous example being 3M's Pollution Prevention Pays (3P) program.

Yet the question of how sustainable entrepreneurship can "provide the creative destruction of unsustainable practices and their replacement with sustainable technologies" (Cohen & Winn, 2007: 46) remains open, in large part because we lack a systematic way to characterize the uncertainties facing sustainable entrepreneurs and the potential benefits and collective action challenges that players face across the opportunity spectrum.

Following recent calls for system-level approaches to sustainable entrepreneurship (Muñoz & Cohen, 2018; Jones et al., 2019), we propose below a collective action perspective that can help push this literature forward. The framework provides a systematic mapping of entrepreneurial opportunities for sustainable entrepreneurship under different degrees of uncertainty. Recognizing that entrepreneurial opportunities are linked to changes in supply and/or demand (Patzelt & Shepherd, 2011; Shane, 2000; Dew, Sarasvathy & Venkataraman, 2004), we show how entrepreneurs can identify or create opportunities in markets with varying degrees of supply and demand uncertainty. Moreover, the framework is not restricted to cases where private and collective incentives align but also to cases where collective action problems impede or restrain entrepreneurial action, thus allowing for a broader coverage of sustainability efforts across incremental as well as transformational entrepreneurial attempts. Finally, this analytical approach sheds light on the challenges and benefits associated with a wide range of opportunities, which in turn allows for a better assessment of the trade-offs of sustainable entrepreneurship in different markets.

MARKET UNCERTAINTY AND SUSTAINABLE ENTREPRENEURSHIP: AN ORGANIZING FRAMEWORK

The impact of ambiguity and uncertainty on markets has long been noted by economists and sociologists alike (Knight, 1921; Alchian, 1950; DiMaggio & Powell, 1991). Market uncertainty can emanate from both the demand side and the supply side in markets. Demand uncertainty is manifest in the absence of cognitive recognition of a new product or service and/or its value, whereas supply uncertainty is associated with the absence (perceived or real) of the necessary inputs to produce and deliver a given good or service (see Lee et al., 2018).

These dimensions of supply and demand uncertainty are fundamental to market formation opportunities and challenges (Struben et al., 2020; Sarasvathy & Dew, 2005) and are particularly relevant for entrepreneurs trying to address systemic sustainability challenges that are inherently complex. For example, demand uncertainty exists when it is unclear whether consumers are willing to switch to alternative sustainable products. Such unwillingness may be grounded in deeply engrained habits, lack of knowledge regarding the attributes of the product, or apathy or doubt concerning the claimed environmental benefits of the product.

Supply uncertainty in sustainable markets exists when there is lack of clarity regarding which technology will provide the best environmental outcome or whether the technology can be developed profitably and at scale. Supply uncertainty may also stem from the fact that many negative externalities associated with conventional production are not accounted for in market prices, thus making any new technology look exorbitantly costly. In sustainable markets, one may expect to find a relatively high frequency of situations with high demand uncertainty and/or supply uncertainty because while environmental challenges have in many cases been long understood, how to resolve them via markets has yet to be fully realized.

Entrepreneurs and other interested actors have a strong interest in mitigating uncertainty because for markets to be viable, social structures must be constructed to facilitate exchange, competition, and production (White, 1981; Fligstein & Dauter, 2007). Establishing a product category, developing rules of exchange, creating industry standards and industry associations, lobbying for state regulation, or achieving product taken-for-grantedness are all examples of market infrastructure that involve collective action to successfully develop (Lee et al., 2018; Fligstein, 2001). By contrast, other actions such as formulating strategy, conducting market research, creating product narratives, investing in R&D, building capabilities, or establishing supplier relationships, are usually actor-oriented efforts. The potential for actor-oriented versus collective approaches to resolve the uncertainty that entrepreneurs face depends on the degree of supply and demand uncertainty in a given market.

To illustrate the importance of supply and demand uncertainty for the context of sustainable entrepreneurship, we have developed a 2x2 matrix with demand uncertainty on the vertical axis and supply uncertainty on the horizontal axis, shown in Figure 14.1. The classification provides a compelling way to categorize and evaluate sustainable entrepreneurial opportunities. Below, we describe each quadrant in turn. We highlight the entrepreneurial opportunities that characterize each quadrant, identify key challenges that entrepreneurs face, and outline the sustainability benefits associated with the successful exploitation of such market opportunities. We use this as a springboard to identify unexplored future research directions for understanding market opportunities as they map across the different quadrants and highlight how the framework as a whole can be used as an organizing framework for the study of sustainable entrepreneurship and market creation and evolution.

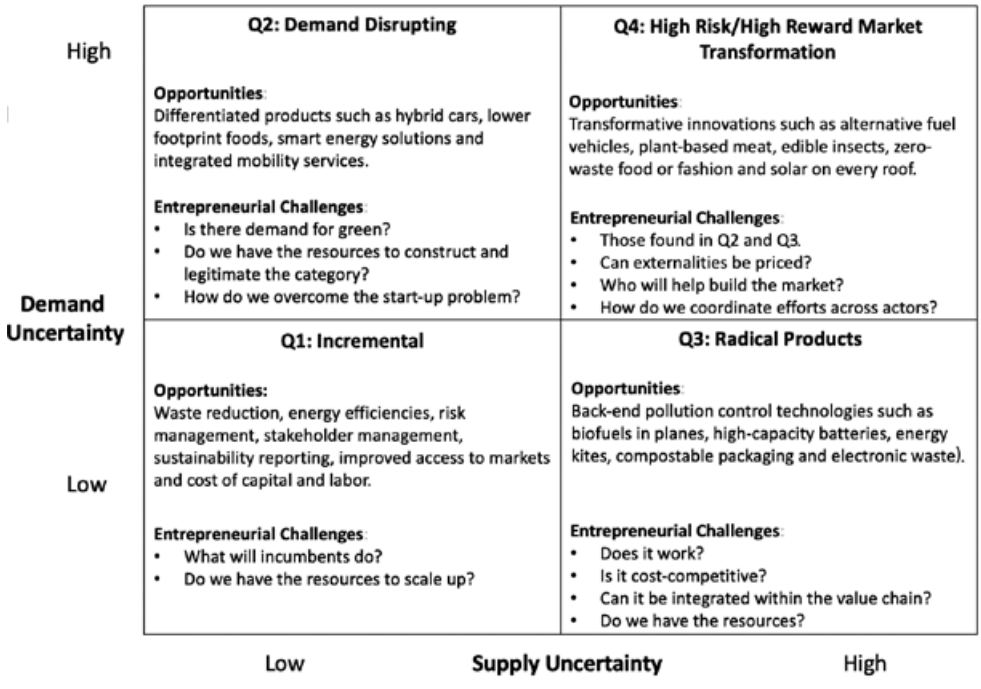

Figure 14.1 *Market formation uncertainty and entrepreneurial opportunities and challenges*

Quadrant 1: Low Demand Uncertainty and Low Supply Uncertainty

Entrepreneurial opportunities in this quadrant arise from within existing markets where negative externalities are generated by incumbent players and industries, allowing prospective entrepreneurs to offer versions of existing products, services, or practices to address the negative externalities while meeting the existing demand. Examples of innovations in this quadrant include advances in existing solar panel design or energy efficient appliances, and environmental services such as risk mitigation or energy audit services. These types of markets rely on existing solutions that are underutilized or that may be localized to a single geographic location but can make the production or use of existing products more energy efficient, less polluting, or can mitigate waste or increase recycling and reuse of materials. Because these opportunities are rooted in existing market practices, entrepreneurs can resort to "standard business logic" when interacting with customers, suppliers, investors, or other stakeholders—translating the sustainability issues into usual strategic considerations (Hoffman, 2018). Finally, entrepreneurs operating in markets found in this quadrant benefit from the existing market infrastructure in the form of necessary regulation, existing knowledge structures, input factor markets, and existing norms, all of which facilitate entrepreneurial activity in these markets.

A primary challenge for the entrepreneurs in this quadrant are the competitive dynamics they face. Given the low supply and demand uncertainty, barriers to entry into these markets

can be lower than in those in other quadrants as entrants do not need to build new market infrastructure. However, if entrepreneurs successfully scale these markets, they may capture the attention of incumbent firms that occupy powerful positions in the conventional market (Hockerts & Wüstenhagen, 2010) and may use their market power, economies of scale and extant capabilities, to enter this newly created market space and outcompete the entrepreneurial firms that pioneered it. Finally, markets in quadrant 1 often rely on efforts to reduce costs or optimize current offerings within existing product lines; this creates competition with extant offerings, which may indicate that these are not big growth markets. Heightened competition with incumbents, or among entrepreneurs, may also result in fewer opportunities for entrepreneurs to capture large market shares.

From the perspective of sustainability impact, low demand uncertainty and the existence of requisite supply-side inputs enable sustainable innovations and business models to diffuse more rapidly than those found in other quadrants. Nevertheless, while entrepreneurs may be able to develop their venture and improve existing markets, their success tends to reinforce the status quo and promote incrementalism. They rarely address systemic impacts, and their potential for transformational impact is limited (Hoffman, 2018). Moreover, successful efforts in such markets (e.g. efforts to grow bio-based fuels such as ethanol) may crowd out more impactful alternatives (e.g. adoption of zero carbon alternatives). Similarly, potential energy reduction gains achieved from efficient technologies may be suppressed because of direct and indirect rebound effects—as consumers pay less for their energy, they may end up using their savings to spend more on other unsustainable products and services.

Quadrant 2: High Demand Uncertainty and Low Supply Uncertainty

For entrepreneurs in this quadrant opportunities arise primarily from leveraging existing technologies, knowledge structures, and/or input factor markets to achieve greater sustainability results than what currently exist in a given market. There are also opportunities for scaling existing niche products or services to a broader, mass market or to new consumer segments. Specific examples include the adoption of smart energy solutions for homes, green household products, or low meat diets. While smart energy management technologies, eco-friendly cleaning products, and plant-based alternatives such as tofu have long existed (hence, supply uncertainty is low), demand for these products has historically been relatively uncertain because they are incongruent with predominant consumer behavior and norms. If entrepreneurs find ways to mitigate demand uncertainty, however, these markets carry significant untapped potential.

A major challenge for sustainable entrepreneurs in markets in this quadrant is to not only market their specific product, but also to construct its category. This is much easier when demand uncertainty is lower; that is, when a new sustainable product is conceived as an environmentally superior substitute for the conventional product and people already recognize it as an existing product category. For example, producers of early hybrid vehicles did not have to actively market the product category of "car"—they simply had to market the specific attributes of the hybrid that set it apart from conventional cars. By contrast, entrepreneurs must dedicate significant resources to educate consumers about the features and benefits of plant-based diets, and to convince them to change their eating habits.

Regardless of whether the product or service constitutes an entirely new product category or a sustainable substitute within an existing category, entrepreneurs still must demonstrate to

consumers that their product or service is of at least similar quality as conventional alternatives. Historically, most green products have entailed greater costs than similar conventional products, and thus consumers often perceive a trade-off between product sustainability attributes and product quality (Raghunathan, Walker Naylor & Hoyer, 2006). Moreover, higher costs—and subsequently higher price tags—suggest that by following an established differentiation strategy for green products, mass adoption is difficult. For example, only 3% of the total household and laundry product market is held by green household cleaning products (Packaged Facts, 2015) and organic food constitutes only 4% of total US food sales (USDA, 2014).

Transforming niche markets into mass markets is complicated by existing norms, culture, and social structures that reinforce existing consumer behavior. Doing so is generally beyond the ability and resources of a single entrepreneur or firm. Thus, another critical challenge for entrepreneurs operating in this quadrant is to overcome the collective action challenge of increasing consumer awareness and acceptance for their respective product categories and products. Efforts to educate consumers of the value of a new product are non-excludable, meaning that competitors seeking to play in the same market will also benefit from the marketing and educational efforts or pioneering entrepreneurs. This can lead to a start-up problem (Marwell & Oliver, 1993) which occurs when the costs for an actor of contributing initially outweigh the benefits. In turn, this may lead to a situation where no one is willing to make the first move and the market never takes off. On the other hand, if some actors (e.g. entrepreneurs, social movements, scientists, government entities) are willing to bear the cost of educating consumers, that opens the door for freeriding, where actors deliberately withhold contributions and instead allow others to do the initial hard work in creating demand for the product. Overall, because of the educational and signaling efforts involved, many early investments to build legitimacy or consumer awareness may not be recouped for individual firms, making the task of mitigating demand uncertainty a collective action problem.

In terms of sustainability impact, this quadrant has significant potential because the environmental improvements are not hindered by supply side complications such as product delays, R&D output, or infrastructure build up and value chain coordination. Rather, the impact comes from changing consumer behavior. For example, there is large potential to reduce carbon footprints by changes in diets (Reisch, Eberle & Lorek, 2013), as the substitution of meat for plant-based alternatives can reduce greenhouse gas emissions considerably (McMichael et al., 2007). A transition to a plant-based diet would significantly decrease these methane emissions, which constitute 16% of total greenhouse gas emissions (IPCC, 2013). Plant-based diets are also healthier for individuals, have less impact on ecosystems, and a plant-based agriculture produces more food with fewer resources, which increases food security. Many other available solutions in other industries and sectors such as substituting air travel for train travel can make a significant impact.

However, for these alternative practices to have significant impact, mass market adoption is critical. Achieving this is not only uncertain but also takes time. For example, many food consumption choices are closely tied to cultural practices (Thøgersen, 2010) and so a change to a more plant-based diet would require a large societal shift. Further, cognitive limitations and socio-behavioral influences may lead consumers to take fewer actions than what is possible. For example, consumers have difficulties sorting through alternative categories with many products promoted as sustainable, but with only few having demonstrable impact (Prado, 2013). In the case of mobility, consumers have difficulty differentiating between the impact of

hybrid electric vehicles and the more radical battery electric vehicles. Adoption of alternative practices may also produce several unintended consequences under high demand uncertainty. For example, even if consumers adopt the product, they may not use it in the intended way, nullifying the environmental impact. Further, policies implemented without care may threaten food security for certain individuals. For example, rice paddies, a large methane contributor, are a main dietary staple for many countries and replacing them could jeopardize food access for those communities. Likewise, local economies and employment can be threatened in communities which currently rely on industrial, large-scale farming practices for their livelihood.

Quadrant 3: Low Demand Uncertainty and High Supply Uncertainty

Markets in this quadrant are characterized by high potential demand but the supply-side solutions either do not exist, are not able to scale due to lack of product–market fit, are too costly, or face competition from incumbent players. In short, these markets embody the aphorism, "build a better mousetrap and the world will beat a path to your door." In the context of sustainable entrepreneurship, these types of markets arise when there is a demonstrated need to remedy an environmental problem via market mechanisms. This demand is more likely to exist when the alternatives promoted by entrepreneurs provide limited disruption to consumers' lifestyles. For example, sustainable alternatives to plastic would face limited demand uncertainty, provided that they are functionally equivalent and offered at a similar price.

Opportunities for entrepreneurs in this quadrant are abundant and can have potentially massive payoffs. For example, it is estimated that the amount of plastic in the ocean is 150 million metric tons with that number growing to 600 million metric tons by 2040 if things remain the same (Parker, 2020). There is clear demand to solve this growing environmental problem. Among the many possible solutions that could address this massive environmental issue are bio-based polymers or bioplastics that use naturally derived feedstocks and/or use biological processes for their production. Given the environmental benefits associated with bio-based polymers such as greenhouse gas emission reductions, biodegradation and energy efficiency, these polymers are a possible solution to the plastic pollution problem. Such polymers have been commercially produced for a long time—vulcanized rubber is one example—but petroleum-based synthetics, being cheaper and more versatile, have dominated the market. As a result, the total market share for bioplastics is only about 1% despite ostensible demand to address this environmental issue because the supply-side uncertainties are challenging and delay market formation.

The existence of robust demand, however, creates massive incentives for entrepreneurs to address supply-side uncertainties via innovation. For example, entrepreneur Mark Herrema of Newlight Technologies worked for ten years to develop a novel biocatalysis process using an enzyme technology that uses methane (a potent greenhouse gas) to make plastic. These innovations have enabled his product AirCarbon to be cost-competitive with conventionally produced polymers, but has the added benefit of being carbon negative, meaning that its production captures or destroys more carbon dioxide than was emitted to make it (https://www.newlight.com/aircarbon). Mark Herrema and his company exemplify the kinds of opportunities this quadrant can afford persistent entrepreneurs. Finding and patenting pathbreaking technologies can provide first mover advantages. Other first mover advantages in these types of markets may involve the chance to set the standards in line with one's capabilities and becoming the de facto market leader.

Despite the potential payoffs for breakthrough innovations, major challenges exist for entrepreneurs operating in this quadrant. Entrepreneurs face the uncertainty of whether the resources they possess suffice for scaling within the requisite time frame, and the unproven nature of the technologies entrepreneurs are developing in these markets means that they are inherently high risk. In many cases, given the interdependent nature of many technologies in terms of knowledge, distribution and standards with existing systems (Agarwal, Moeen & Shah, 2017), decisions cannot be made in isolation. This need for coordination further increases the risk associated with developing these technologies. For example, in the transportation sector there are major uncertainties about what energy sources may fuel future mobility (electricity, hydrogen, or more efficient conventional biofuels). In the case of electric cars, there are uncertainties regarding which battery type (liquid lithium-ion, solid state lithium-sulfur, lithium-ion etc.) will become the standard. Further, for each of these types of batteries, there are many possible technological design approaches and standards that market actors across the value chain have yet to agree upon. In sum, entrepreneurs operating within these value chains face large risks due to unclear time horizons, uncertainty about obtaining funding for R&D, and interdependence with other incumbent players and dominant technologies.

For markets in this quadrant, a key sustainability benefit is that a completely new set of options may become available to address the negative externalities of the current system. A fundamental idea within economics is that externalities are internalized in the pricing, but this assumption is often violated, creating opportunities for sustainability impact though entrepreneurial activity (Cohen & Winn, 2007). For example, investments in renewable energy technologies and the deployment of solar and wind energy have led to a decline of coal-based electricity production, which has been a large contributor to GHG emissions (World Bank, 2014). If successful, green technologies such as nuclear fusion can also provide a step change to accelerating carbon emissions mitigation.

Yet, the promise of a technological panacea is also dangerous. The hope for unproven silver bullet alternatives can crowd out investment in and preempt efforts to scale up efforts behind mixes of proven but less exciting alternatives. Consider, for example, Carbon Dioxide Removal (CDR) technologies that pull carbon out of the air. These technologies are unproven and not widely used, and most approaches face significant barriers to deployment. Yet, such solutions are much discussed in the media and favored by thought leaders as "silver bullets," as illustrated by Bill Gates' call to pursuit technological CDR as a climate miracle (Vidal, 2018). Such attention to technological solutions may also draw attention away from the fundamental need to alter consumption practices, necessary to avoid pressing climate change impacts.

Quadrant 4: High Demand Uncertainty and High Supply Uncertainty

Markets in this quadrant are characterized by both lack of demand for a potential new product or service and limited present supply-side elements. In many cases, these markets are at very early stages in their development and actors have yet to substantively begin to address demand- and supply-side uncertainties. Collective action is sorely needed to foment demand and address complex supply-side decision making and coordination. In the context of sustainable entrepreneurship, these types of markets exist when there is an externality to be addressed but there is limited understanding of the nature and scope of that externality. Furthermore, there can be uncertainty regarding how potential solutions may interface with market mechanisms and demand-side consumption patterns and practices. Uncertainty may also exist

regarding how nascent solutions can effectively scale or because the solutions may conflict with prevailing consumer attitudes and practices. Nor is it clear how the required solutions can be provided effectively and profitability. As a result, there are limited incentives for the development of supply-side solutions to satisfy unclear demand for solutions to environmental problems.

Consider how existing food systems face myriad challenges—increasing population, resource scarcity, climate change, and food security concerns. All of these issues are prompting a re-evaluation of the sustainability of existing food production, distribution, and consumption practices and products. Entomophagy (the use of insects for food) is a nascent market that has the potential to fundamentally address some of the sustainability concerns outlined above. However, the market faces high levels of demand and supply uncertainty. While using insects as a food source is common in some countries, most people in Western countries view such a practice with disgust and fear and regard it as primitive behavior (Dobermann, Swift & Field, 2017). Western consumers are therefore hesitant to alter their consumption practices, even where these products are available in supermarkets or restaurants. These practices are strongly rooted in culture and constitute a source of demand uncertainty for those seeking to create a market for edible insects in Western countries. In addition to this demand-side uncertainty, supply-side uncertainties revolve around food safety and nutrition management issues (e.g. microbial risks, toxicity, allergic reactions, anti-nutrient properties, and variable nutritional value), production concerns (e.g. R&D, production technologies, automation, and efficiency), and regulation (e.g. ambiguous or nonexistent regulations and laws for insect consumption). Other markets-in-formation exhibit similar high demand and supply uncertainty, such as hydrogen-based airline and electricity-based private road transportation.

Precisely because of the large uncertainties there are opportunities for entrepreneurs to benefit from early mover advantages, similar to those indicated in opportunities for quadrants 2 and 3. Yet, in this case, such upsides may be larger and more fundamental because early movers cannot only benefit from economies of scale but are not constrained by extant market infrastructure and so can set the rules of the game on their terms—determining standards, shaping consumer preferences, and moving into the most attractive consumer categories. In the edible insect industry early movers such as Aspire Food Group have been able to secure funding and develop a vertically integrated chain of larvae farming, commercial scale cricket raising, and commercialize initial product lines including superfoods and pet foods within this still nascent and uncertain industry.

Because markets in this quadrant combine characteristics of both quadrants 2 and 3, the challenges identified in quadrant 4 are magnified. However, the combination of supply and demand uncertainty also creates fundamentally new challenges. Start-up problems occurring in this quadrant are particularly challenging because success not only requires alignment and coordination across actors to assure the effective production and distribution of established technologies, but these efforts have to take place without a promise of demand or clarity about the sorts of solutions consumers like. Development of edible insect markets, for example, requires coordination across a value chain of producers (insect rearers), processors, distributors, retailers, restaurateurs, and consumers. And to successfully form a viable market for edible insects will most likely require the efforts of other actors as well. Industry associations and standards bodies have to work to develop quality standards and lobby government for favorable regulation. Government agencies will have to develop a regulation that legally defines the category and enforces minimum health and safety standards. NGOs and move-

ments could work with producers to shift norms and cultural stigmas surrounding human consumption of insects. All of this requires the alignment of distinct resources that each of these actor types bring to the market. If actors are unable to achieve this alignment, collective action problems are multiplied, and all actors will experience greater uncertainty as a result. In the edible insect market, hundreds of start-ups have disappeared (Engstrom, 2020).

These start-up problems can have major consequences for the market as a whole, including failure or significant delays. This is vividly demonstrated in the automotive industry by the failure of Better Place, which set back advances in automotive electrification, as discussed in our introduction. Occasionally, a visionary actor with deep pockets can make massive investments, shaping and developing markets in this quadrant, thereby avoiding some of the coordination challenges. Yet such paths are still fraught with enduring failure risks. For example, Elon Musk's Tesla, having partially relied on external government support for bailouts, battery factory development, and consumer purchase subsidies, took ten years to become profitable and has yet to achieve his goal of mass-commercialization of the electric car (Ayre, 2018).

Given the highly novel and uncertain nature of these markets, the potential for impact is also uncertain, particularly in cases where there is limited understanding of the scope of the externalities to be addressed. But generally these are markets with high impact potential, insofar as entrepreneurs and other actors involved manage to construct market infrastructure on both the supply and demand side. For example, geoengineering, defined as a set of technological interventions into planetary systems to manipulate the Earth's climate, is ripe with controversy. Supply uncertainty is inflated as the technology is unproven and its consequences unknown. And demand is unpredictable as actors grapple with the ethics of whether, and by whom, decisions about "adjusting the world's thermostat" should be made (Augustine et al., 2019). The promise, however, is enormous with some hailing geoengineering as the last chance to save the planet (Anshelm & Hansson, 2014). The case of geoengineering, therefore, exemplifies both the heightened uncertainty of markets in quadrant 4, but also the uncertainty regarding their potential impact on climate change mitigation efforts. As with quadrant 3 markets, the danger is that unproven market solutions may be seen as silver bullets that allow us to continue living unsustainably or crowd out investments in more feasible alternative solutions.

DISCUSSION AND RESEARCH AGENDA

Sustainable entrepreneurship is a growing field, garnering greater attention and relevance as the world increases its understanding of the scope and magnitude of the climate crisis. Yet the literature on sustainable entrepreneurship has largely mapped onto the trajectory of our understanding of "conventional entrepreneurship"—that is, that opportunities are conceptualized as independent of entrepreneurs and rooted in market failures and imperfections (Muñoz & Dimov, 2015). The focus on opportunities that are "out there" to be discovered, rather than on the creation of entrepreneurial opportunities, leads to an emphasis of win–win solutions that promise a fast and easy payback. This approach constrains the study of sustainable entrepreneurship to contexts where individual and collective incentives align, and at worst, it may lead entrepreneurs to focus on the "low hanging fruit" at the expense of riskier but potentially more rewarding transformational solutions that would more effectively or comprehensively address sustainability challenges. Historically, the dominant mode of technological innovation has been incremental in nature (Mokyr, 1992) and research on the greening of business suggests

a similar pattern—that most environmental solutions to date have been quite incremental (Ambec & Lanoie, 2008).

Things must change. Hoffman (2018) suggests that approaches of "tinkering around the edges" are reaching a point of diminishing returns and are not enough to address the massive sustainability challenges we face. Instead, he proffers "sustainability 2.0 solutions"—efforts that are focused on systemic, transformational changes to the way that markets function.

Our purpose in this chapter has been to address this shortfall in the literature by broadening the scope of sustainable entrepreneurship; we set forth a framework to better understand the challenges and opportunities that sustainable entrepreneurs face across varying degrees of supply and demand uncertainty. More radical solutions such as those located in quadrants 2, 3 or 4 can have a big impact and therefore merit more sustained and extensive scholarly attention. These more transformational opportunities tend to require the adoption of longer time horizons and the development of novel technical or organizational capabilities due to the presence of high uncertainty. Collective action may be needed to build a range of market infrastructure such as developing requisite standards and regulation, coordinating value chains, legitimating new product categories, and shifting consumer behavior (Jones et al., 2019; Struben, Chan & Dube, 2014; Lee et al., 2018; Bridoux & Stoelhorst, 2020). Drawing upon existing research and the framework provided in this chapter as a starting point, we identify several promising directions for further research below.

Private- vs. Market-Oriented Resource Allocation

For individual entrepreneurs, a key dilemma is how to position themselves vis-à-vis existing opportunities and how to allocate the scarce resources they possess. Many sustainable entrepreneurs cobble together viable sustainable business models from various elements—leveraging existing resource and input factor markets, extant supply chains, proven marketing channels, and pre-existing norms, and regulations that favor their venture. This pathway generally results in entrepreneurs creating value for themselves and their customers through the allocation of private-oriented resources to develop and market an environmentally friendly alternative to what conventional markets offer. This approach is consistent with conventional admonitions from strategic management scholars for firms to search for competitively advantageous positions in a market and then allocate resources in such a way that allows them to attain competitive advantage (Schilling, 2002). Despite the potential for significant private gains, this differentiation approach is limited in terms of broader sustainability goals given the relatively smaller customer niche targeted.

Other sustainable entrepreneurs attempt to fundamentally shape the infrastructure of markets or to create entirely new markets. In these cases, simply focusing on developing their individual venture by allocating privately oriented resources (such as R&D or brand marketing) is insufficient. Collective action problems accumulate and markets eventually fail if no one is attending to the development of critical market infrastructure (Struben et al., 2020). Because resource allocation decisions are intimately tied to collective action problems and solutions (Lee et al., 2018), how sustainable entrepreneurs choose to allocate and mobilize resources is consequential for the emergence and development of sustainable markets. To our knowledge, scant research to date has examined fundamental questions regarding the nature of the resources that entrepreneurs allocate to building their firms versus the market. More research is needed to understand how entrepreneurs make decisions regarding which

resources to allocate when, and under what conditions. Finally, greater understanding of the consequences of such decisions would represent an important theoretical advancement that could also inform government policy and entrepreneurial decision making.

Overcoming the Failure of Collective Action

Entrepreneurship scholars have begun to address collective action problems such as the tragedy of the commons and freeriding (see Sarasvathy & Ramesh, 2019; York, Vedula & Lenox, 2018). However, our framework points to the more fundamental start-up problem that characterizes many market formation efforts found in quadrants 2–4. The start-up problem occurs when all interested actors can see that it would be beneficial for market infrastructure to be developed, but no one contributes because the returns on that contribution are very low. As a result, interested actors all wait around for someone else to make the first contribution, which does not happen and the market fails (see Lee et al., 2018). More research is needed to understand whether and to what extent the start-up problem exists for sustainable markets. This requires more research focused on the very early moments of market formation and on markets that fail to form (Ozcan & Santos, 2015). Most extant research on market formation relies on data collected only after the market has begun to form, which means that early critical collective action problems evade the purview of scholars. We also see value in comparative approaches to market formation, both across markets residing in different quadrants and, where possible, of "conventional" and "alternative" markets for the same products.

Coordination Challenges

Understanding how and when coordination may break down during market formation efforts is another critical future research direction. Sustainability markets tend to include a more heterogeneous array of actors—from the public, market, or civil society spheres—compared to conventional markets, and those actors may have different values and ideologies (Georgallis & Lee, 2020). Thus, the successful expansion of these markets often depends on a collective effort that involves entrepreneurs and incumbents, private and public organizations, regulators and NGOs. While important, such collective attempts are far from perfect and difficult to navigate. Yet we still don't know enough about what the joint presence of these actors means at the level of the market (Struben et al., 2020), and how it affects collective action in particular.

Many of the early mover entrepreneurs in market formation efforts (particularly those found in quadrant 4) are likely the zealots (Coleman, 1988)—those driven by ideology, vision, obsession, or other non-pecuniary motivations. In the context of sustainability, these zealots tend to be concerned less about private benefits and more about public good, while later mainstream entrepreneurs and incumbents may step in to grasp the opportunities created by the more committed early movers (e.g. Hockerts & Wüstenhagen, 2010). These important junctures in market evolution are precisely the instances when coordination may break down, as these actors have different identities, goals, and visions for the market. The actors can disagree on the means (e.g. to work from within the incumbent market infrastructure or break from it) or ends (e.g. whether the market should be a niche or become the mainstream offering). The identification and empirical exploration of these critical junctures and thresholds are critical for a more detailed and causal understanding of market formation dynamics.

When a market reaches a critical point where key actors disagree on how to proceed, we can imagine several possible paths. One is a breakdown in negotiations with the market failing or remaining a niche for the "hardcore" and ideologically committed sustainable entrepreneurs; another is that incumbents and less committed entrepreneurs "take over" the market; and yet another is reconciliation and compromise so that the market can keep growing. Studying potential pathways out of "lock in" situations is paramount for understanding how markets can outgrow their niches.

Market Participants Beyond the Entrepreneur

As mentioned from the outset, it is rare that a single entrepreneur is able to singlehandedly orchestrate a new sustainability market. Thus, a focus on the panoply of actors that have an interest in the market is essential. Standard setting organizations, social movements, public bodies, and other non-market actors have been important in the emergence of sustainable markets (e.g. Jones et al., 2019; Lee, Hiatt & Lounsbury, 2017). For example, industry associations facilitate collective action (Russo, 2001), and social movement organizations act as mobilizing structures coordinating resource provision (Sine & Lee, 2009). Social investment forums have coordinated collective action around green investing; and Greenpeace organized several conferences and demonstration projects for renewable energy. But not all moral markets benefit from strong social movement support, and this has implications for the coordination of collective action (Georgallis & Lee, 2020). When there is limited support from social movements, industry associations or even the state may need to play a more active role in coordination. While some research has examined how intermediary actors affect processes of market emergence, the interactions and potential complementarities between intermediaries as industries evolve merit more attention.

Evolving Market Uncertainty and Pathways to Sustainability

Beyond better understanding the opportunities, challenges, solutions, and impacts within each quadrant, we call for more dynamic perspectives about high impact sustainability pathways. That is, we need to better understand the implications of markets moving from quadrant to quadrant as they evolve (Lee et al., 2018). A prevalent view in evolutionary perspectives is that markets move in a stepping-stone way towards high impact (Berkhout et al., 2010; Westley et al., 2011). However, it is an open empirical question whether this happens. Markets are prone to "lock-in" effects and path dependencies and pressures to pursue intermediate solutions or solutions within existing market infrastructure which may result in a suboptimal outcome. For example, natural gas, often touted as a stepping-stone towards a fully carbon-free electricity sector, may crowd out the funding and development of renewable resources (Gürsan and de Gooyert, 2020). Such incremental pathways may be simply too slow for the challenges our societies face. Overall, we urge researchers to take into account both the trajectory of markets but also the pace at which they evolve and what that means for achieving meaningful sustainable change.

Stimulating Sustainable Market Formation

The different challenges that actors face imply that efforts to stimulate the formation of markets will differ by quadrant. By the same reasoning, the type of coordination and stimulation required for forming sustainable markets—and at a pace so they make an impact—is very much tied to the level and nature of market formation uncertainty.

For example, within quadrant 1, to stimulate the adoption of an existing environmentally preferable good or service, governments may put in place purchasing policies that require a percentage of purchases to be from more environmentally friendly sources, creating incentives for incumbents and start-ups alike to begin supplying greener goods and services to the government. Similarly, incumbent companies may establish supplier policies that encourage greener practices within their supply chains. Such efforts may not suffice when demand or supply uncertainty is high. In quadrant 2, market formation would more likely benefit from governments and third parties contributing to the education of the public about the unsustainability of established practices and the value of alternatives. Effective stimuli may also involve creating regulation or creating stringent standards and labeling schemes so that consumers can easily evaluate the differences between alternative options with respect to their sustainability benefits. In quadrant 3, because of the uncertainty regarding production and distribution, forming markets may require strong pricing signals (e.g. carbon pricing) or quotas (e.g. renewable portfolio standards) that speed up a switch to alternatives under high economic rather than technological uncertainty. Finally, markets in quadrant 4 may require strong pricing signals as well; but in addition, entrepreneurs operating in these markets may require assistance in coordination efforts with other market players. For example, third parties and government actors may help develop a common platform and roadmaps to reduce uncertainty and use field configuring events (Hardy & Maguire, 2010) to facilitate collective action. Future work should help us better understand how government and non-profit/social movement organizations can influence market growth in the various quadrants.

Aligning Private and Public Interests

Building sustainable markets is not just a challenge of market-oriented efforts but also of aligning societal interests with private-oriented efforts. Thus, governments can intervene to render opportunities (that would otherwise be unprofitable) more attractive to potential entrepreneurs. These may differ by quadrant. For example, policy interventions in quadrant 1 may be minimal, such as standard setting and mandates of transparency. Requiring companies to simply report environmental, social, and governance risks creates a "soft push" as it allows other stakeholders to monitor and potentially steer firms' behavior. In quadrant 2, governments can focus more on public education campaigns (e.g. what is transportation as a service; how to use smart-meters) or enact demand-pull incentives. In quadrant 3, the focus may be more on technology-push policies, including basic R&D, production subsidies, or potentially even quotas (e.g. amount of plastic in packaging) that become more and more stringent to gradually internalize externalities and incentivize firms to innovate for new solutions. Finally, quadrant 4 might require a combination of demand-pull and technology-push policies but also fostering opportunities for coordination of market actors, as discussed above.

These decisions, however, do not come without trade-offs. First, *perceived* societal interests are not fixed but malleable, and government interventions often face opposition from

incumbent groups or even from the public. It may thus be necessary to "sell" a policy on other, sometimes secondary, benefits to get the public on board with increased spending. It may require, for example, that policy-makers frame sustainability policy as industrial policy: the support of entrepreneurship and job creation. Second, insofar as they can support sustainable entrepreneurs, policy-makers need to make a choice among several alternatives (liquid natural gas vs. solar panels; hydrogen vs. electric vehicles), or support a general platform, or "bet" on multiple horses (but less on each). These issues are complicated because some solutions yield faster returns, others are more promising but riskier; some require concentrated efforts (e.g. one key technology) and others require efforts on multiple fronts (competing technologies, but also demand-side plus supply-side interventions); some face stronger opposition from incumbents and others less so. And additional trade-offs relate to the timing of government intervention: when to incentivize markets? When to push for scaling up? And when is it time to give up? Future research is needed to provide specific recommendations for how governments can navigate these trade-offs, but we expect that the supply and demand uncertainty linked to different opportunities will be central in such considerations.

CONCLUSION

The unprecedented growth in human prosperity that societies have witnessed since the industrial revolution is threatened by the very production and consumption patterns that underlie our modern lifestyles. As climate change threatens the future of humanity, many look to sustainable entrepreneurship to create markets that balance economic with social and environmental sustainability. As sustainable entrepreneurs venture into these markets they face substantial uncertainty, but the implications for entrepreneurs and for sustainability are not well understood. In this chapter, we advance a framework to characterize sustainable markets across the dimensions of supply and demand uncertainty. The framework allows for a more comprehensive understanding of the challenges facing entrepreneurs, and of their potential sustainability impact.

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NOTES

1. This chapter is published under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 Unported (https://creativecommons.org/licenses/by-nc-nd/4.0/) license.
2. The scope of sustainability and sustainable entrepreneurship involves many interrelated dimensions beyond climate change, including biodiversity, poverty, access to food and water, and social equity. While our arguments and framework apply to sustainability issues in general, for analytical clarity the examples we use in this chapter are focused on the context of climate change.
3. We follow Lee et al. by defining market infrastructure as "material and socio-cognitive elements supporting the functioning of a stable market that benefits market actors" (2018: 243). Such infrastructure includes but is not limited to: agreed-upon categories, product prototypes, norms of exchange, government regulation, or technology standards.

4. Collective action can be defined as any action aimed at the construction of some collective good (Marwell & Oliver, 1993). As such, collective action problems arise when actors refrain from committing resources that are necessary for the construction of a collective good, even when a majority has an interest in its development.

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