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Transforming Consumption: From Decoupling, to Behavior Change, to System Changes for Sustainable Consumption

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sustainability transition, postgrowth economics

Abstract

Consumption, although often considered an individual choice, is deeply ingrained in behaviors, cultures, and institutions, and is driven and supported by corporate and government practices. Consumption is also at the heart of many of our most critical ecological, health, and social problems. What is referred to broadly as sustainable consumption has primarily focused on making consumption more efficient and gradually decoupling it from energy and resource use. We argue for the need to focus sustainable consumption initiatives on the key impact areas of consumption—transport, housing, energy use, and food—and at deeper levels of system change. To meet the scale of the sustainability challenges we face, interventions and policies must move from relative decoupling via technological improvements, to strategies to change the behavior of individual consumers, to broader initiatives to change systems of production and consumption. We seek to connect these emerging literatures on behavior change, structural interventions, and sustainability transitions to arrive at integrated frameworks for learning, iteration, and scaling of sustainability innovations. We sketch the outlines of research and practice that offer potentials for system changes for truly sustainable consumption.

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THE CONSUMPTION-SUSTAINABILITY DILEMMA

We face a deep cultural and social dilemma: One of the central goals of individuals, corporations, and governments—increased consumption—is also at the heart of our greatest ecological, equality, and health risks (1). As William Greider and many others have warned, “if industrial growth proceeds according to its accepted patterns, everyone is imperiled. Yet, if industrialization is not allowed to proceed, a majority of the world’s citizens are consigned to a permanent second-class status, deprived of the industrial artifacts that enhance life’s comfort, the tools that multiply human choices” (2, p. 13).

Early concerns about the *limits to growth*—the contradictions inherent in the goal of infinite growth on a finite planet (3, 4)—particularly its assimilative capacity, have been compounded with newer concerns about the *limits of growth*—how consumption-led growth consistently fails to satisfy human development and societal goals (1, 3, 5). Global demographic and consumption trends indicate that we face major environmental and human health risks if consumption and production systems continue on current trajectories.

Environmental Impacts

Since 1980, we have exceeded many key ecological indicators (6, 7). Current rates of extinction are 100 to 1,000 times those of normal conditions (8); approximately 60% of the world’s ecosystem

services have been degraded or overused (1, 9). In 2009, an influential study asserted that “three of nine interlinked planetary boundaries have already been overstepped” (8, p. 472). These planetary boundaries, including biodiversity, climate change and nitrogen cycle disruption, are thresholds for environmental degradation processes that put multiple species at risk.

On climate change alone, the data are overwhelming. Since 1990—the base year for many international agreements—global emissions have risen nearly 60% (10), with consumption-based emissions rising at a rate of approximately 3% per year (11). These increased greenhouse gas emissions are overwhelming the planet’s assimilative capacity (12, 13), driving unpredictable climatic shifts, rising global temperatures, increasing droughts, and increasing frequency and severity of storms.

Health and Social Impacts

In addition to environmental risks, affluent nations are suffering from increasing rates of so-called lifestyle diseases such as obesity, heart disease, type 2 diabetes, childhood cancers, and fertility problems (1, 3, 14, 15). The dominance of positional consumerism—consumption driven by concerns for status and social competition rather than utility—has left individuals with greater levels of stress and dissatisfaction (1). A somewhat controversial literature points to indicators suggesting a decreasing quality of life associated with economic growth beyond certain thresholds (1, 16, 17). This research calls into question the assumption of an unending straight-line relationship between economic affluence and well-being (6).

Inequality and Justice

Furthermore, the benefits—economic development, material possessions, etc.—and costs—pollution, waste disposal, hazardous jobs, etc.—of resource use have also been unjustly distributed (12). Environmental justice researchers have documented the inequitable distributions of environmental “bads,” calling into question the ability of economic growth to fairly benefit all communities and address distributional inequities in national, international, and intergenerational contexts (12).

SUSTAINABLE CONSUMPTION AS DECOUPLING

In response to the consumption-sustainability dilemma, a range of initiatives have emerged within the past 25 years under the broad rubric of sustainable consumption. This field was defined by participants at an international gathering in Oslo in 1995 as the “use of goods and services that respond to basic needs and bring a better quality of life, while minimizing the use of natural resources, toxic materials and emissions of waste and pollutants over the life cycle, so as not to jeopardize the needs of future generations” (18, p. 53). They go further to specify that, “the sustainability of consumption acts is defined by the degree to which individual acts . . . contribute to creating or sustaining external conditions that allow all human beings to meet their objective needs today and in the future” (18).

International, national, and local sustainable consumption initiatives have taken up this effort by focusing primarily on improving the material and energy efficiency of products and production processes, with the overarching goal of decoupling economic growth from environmental impacts and resource use. The Organization for Economic Co-operation and Development (OECD) made “green growth” its 2011 slogan (19, 20); the 2012 United Nations Rio+20 Conference on Sustainable Development focused on the “green economy” as its response to the consumption-sustainability dilemma (21). Although they may seem different, green growth, green economy, sustainable consumption, and sustainable development initiatives share a core focus on decoupling negative environmental impacts from the economy through gains in efficiency, framing solutions as a win-win for the economy and the environment.

Technological Efficiency and Decoupling

Innovation focused on “factor ten” efficiency improvements—from product dematerialization, to eco-substitution, decarbonization, energy efficiency, intensifying production, servicing, etc.—has been central to initiatives to decouple consumption and environmental impacts (22). Many multinational companies have voluntarily led the charge in eco-efficiency improvements, especially in areas where they see economic benefit, such as reducing energy, water, packaging, and waste in their supply chain processes and products (23). Between corporate actions and government programs, there have been very real improvements in vehicle fuel efficiency (24), appliance energy efficiency (25), and water use efficiency (26). In a recent debate about eco-modernism, researchers presented a convincing catalog of decouplings in food systems, water use, mineral and oil consumption, air emissions, and more (27).

Greening Markets and Growth

Significant emphasis in both the practice and theory of sustainable consumption has focused on market-mediated sustainability initiatives. Fitting within the green economy, this focus supports market mechanisms directing sustainability innovation. The underlying hypothesis is that “rational” consumers “vote with their dollars,” thereby incentivizing sustainability innovations in the marketplace (28). In keeping with market theories, a primary intervention for policymakers and nongovernmental organizations (NGOs) has been to supply information to consumers on the environmental benefits and impacts of products (28).

A key component of this strategy is better measuring environmental impacts stemming from supply chains and product life cycles. Indeed, we have seen significant improvement in these areas, such as the development of carbon footprints (and carbon markets), life-cycle impact calculators, virtual water calculations, and industry-specific measurement tools such as the apparel industry’s Higg Index (23, 29). The next step in the greening of the economy is to have companies internalize externalized costs to incent innovations in the use of resources, energy, water, etc., and to motivate reductions in pollution and waste. Whether to prepare for future regulation or to unlock economic benefits from efficiency, several companies have begun internally tracking and pricing carbon and even developing environmental profit and loss reports (23).

In some areas, technological innovations and socioeconomic trends have nurtured business model innovations—such as leasing services rather than selling products—that have the potential to make the allocation, use, and end-of-life management of goods much more efficient. We briefly introduce these innovations below, initially only in the forms in which they currently support decoupling strategies. Later, we discuss their implications for broader strategies of sufficiency and sustainability.

Product-service systems. Product-service systems (PSS)—capitalizing on advances in technology and environmental awareness—aim to provide consumers with services typically derived from personally owned products. Through PSS, consumers are freed from the burdens of ownership and can decide when a service is most needed. In theory, this holds the potential to reduce demand for production by enabling a smaller number of products to be more fully utilized by more consumers. Companies are thereby incentivized to make products more durable, to optimize product maintenance, and to extend the useful life of products (30). A well-known example is a company that sells the *service of floor-covering* instead of a carpet product and that has reduced materials flows by 30% (31). Importantly, PSS for transportation have gained considerable market traction, with companies supplying fleets of vehicles available for rent for short periods from decentralized stations.

Collaborative consumption. Collaborative consumption represents a broad collection of business models including redistribution networks, peer-to-peer resource sharing, and PSS (32). Although collaborative consumption, or more colloquially the “sharing economy,” has been common throughout history, in recent years the uptake of advanced technology and increasingly dense urban networks have enabled larger and more efficient networks that scale sharing operations (33). These systems offer the potential for a more resource-light economy (34) while facilitating broader access to products. New online services, for example, have served as robust secondary markets for goods and services. New enterprises have unlocked an entirely new hospitality industry based on people “sharing” their homes; other companies have built systems that facilitate peer-to-peer product swapping, sharing, and donating. The evidence is mixed on whether the sharing economy actually advances resource conservation (35); however, it appears in theory to offer a pathway to less resource and product-intensive consumption.

Circular economy. The circular economy is the newest name for initiatives focused on closed-loop systems for production and consumption. The aim is to redesign value chains to support flows of materials in circular systems, by designing products and infrastructures for refurbishment, reuse, and recycling (36). Extended producer responsibility laws have played an important role in requiring companies to design for end-of-life management and other environmental issues (37), as various industries in large manufacturing economies—Japan, Germany, and China—have implemented circular economy principles (38). If resource constraints drive higher prices, more innovative and integrated systems will likely be developed as society’s “technical metabolism” of energy, water, and materials aims to mimic nature’s “biological metabolism” of resources (36).

THE LIMITS OF WEAK SUSTAINABLE CONSUMPTION

Efficiency-focused sustainability initiatives have an absolutely critical goal of decoupling economic activity from environmental impact. As the IPAT identity ($Impact = Population \times Affluence \times Technology$) (39) lays out, negative ecological impacts increase as affluence and population grow and decrease with technical efficiency improvements. For our purposes here, we refer to technology innovations (the T in IPAT) broadly as strategies to make consumption more efficient, that is, producing more units of output per unit of resource inputs, thereby helping to decouple environmental impacts from economic activity.

Although we continue to see significant improvements in the technological efficiency of production and consumption, there is a major debate in the literature about whether these efficiency initiatives have reduced overall negative environmental impacts and resource use (1, 40–43). When considered alongside rising population and affluence trends, it is critical to evaluate whether these initiatives can support absolute reductions and long-term sustainability imperatives (44). Essentially, although technological efficiency improvements are necessary to meet sustainability targets, we also need to know in which situations and with which strategies they can be sufficient (45).

Growth in Population and Affluence

Current models predict that both population and economic growth will continue to increase throughout the century. Recent population estimates have increased their projected peak population number from 7.2 billion today to 9.6 billion in 2050, to 11 billion by 2100 (46). Economic growth, and the included consumption of resources,¹ is predicted to grow by approximately 2–3%

¹This is true despite the theoretical possibility of total decoupling (see 47).

a Socioeconomic trends

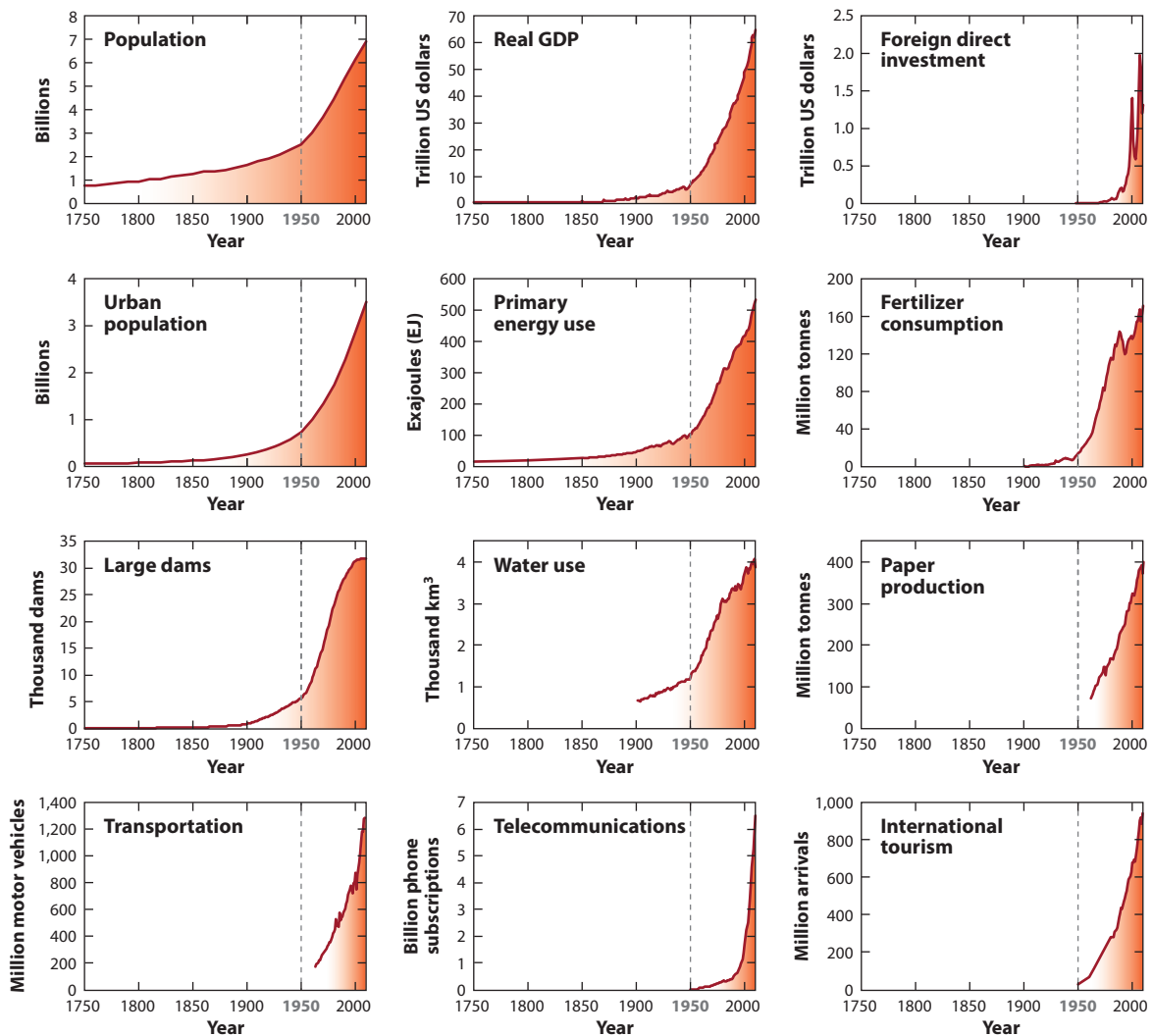


Figure 1

(a) Trends from 1750 to 2010 in globally aggregated indicators for socioeconomic development. (b) Trends from 1750 to 2010 as indicators for the structure and functioning of the Earth System. Figure reprinted from Ref. 49, copyright 2015 by SAGE Publications (see greater detail on data and graphs there).

per year (19, 48) over this same time period. Several scholars have labeled the recent and projected growth period—in population, consumption, and impacts—the Great Acceleration (**Figure 1**).

In this article, we are unable to explore population issues. We treat population as an exogenous variable and essentially a multiplier of impacts. Population of course is not exogenous and can be mitigated by policies such as promoting economic opportunities for women, education and literacy programs, greater access to contraception, decreased infant mortality rates, etc. (46, 50).

b Earth system trends

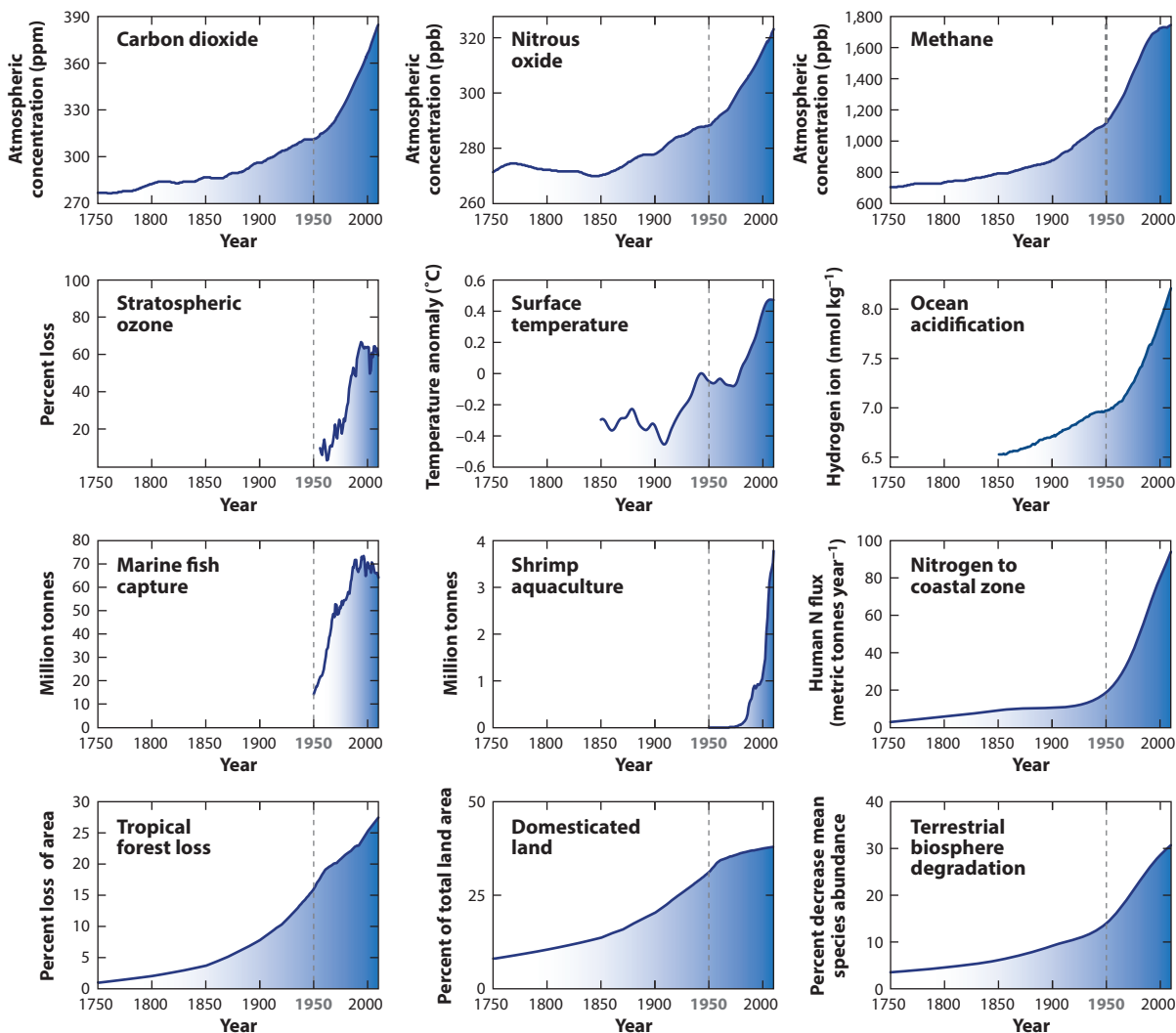


Figure 1

(Continued)

Consumption (the Affluence factor in IPAT) is our focus. Breaking down projected global gross domestic product (GDP) increases of 2–3% per year, we see average per capita income expected to increase by 300% by 2050 (19), with some predicting this increase will arrive a decade faster (51). By 2034, the world economy is projected to be \$200 trillion (in purchasing power parity), up from \$63 trillion in 2009 (51).

To date, developed countries have of course been responsible for most of the environmental impacts from consumption and production. US households, for example, represent 4% of the global population; however, they account for 20% of global emissions of greenhouse gases, with

per capita emissions four times the Chinese level (52, 53). There are some encouraging, although modest, signs of decoupling in developed countries. US per capita vehicle miles traveled, fuel consumption, and number of vehicles all appear to have peaked in 2004 (54), and we have seen energy use reductions in homes and increases in ride-sharing services. Millennials are a key demographic that has shown signs of reducing some forms of consumption (55), such as a declining interest in owning cars (56, 57).

However, a significant portion of future environmental impacts will come from developing countries as they grow. The OECD recently estimated that the global middle class will grow from a population of 1.8 billion in 2009 to 2.9 billion by 2030 (51). The Intergovernmental Panel on Climate Change (IPCC) predicts between 67% and 75% of CO₂ emission increases between 2000 and 2030 will come from developing countries (58).

China presents an important case study, as the largest current emitter of greenhouse gases, accounting for 25% of global emissions (42) even with its relatively low per capita emission level (52). Indeed, China appears poised for a similar consumption-based economic growth model as the West. Chinese per-capita meat consumption doubled from 1990 to 2000, and total cars jumped from one to six million over the same period (59). Average per capita living space increased from 8.1 to 32.4 m² from 1978 to 2008, and energy use from construction increased from 7.89 Metric tons carbon equivalent to 38.12 Metric tons carbon equivalent (60). China now adds over 20 million vehicles per year to its roads (<http://www.statista.com/statistics/233743/vehicle-sales-in-china/>). In 2010, China accounted for 13% of global car sales, up from 1% in 2000 (51), and is now the world's largest car market and the second-largest luxury market (61). Estimates are that by 2020, private consumption will account for 43% of China's economic growth (61), when 75% of the population will be defined as middle class (\$10–\$100 per person per day of spending power) (51).

Other emerging economies such as India are not far behind in creating a global consumer class. In 2000, India had 132 million middle class consumers, with incomes greater than \$10,000 per year, who contributed 15 times greater CO₂ emissions than the rest of their population (59). Consumption levels in India are expected to quadruple by 2025 (62), with half of Indian consumers expected to have middle class incomes by 2025 and 500 million more Indians living in cities by 2039 (51).

The Scale and Scope Required

The recent *An Ecomodernist Manifesto* (63, p. 18) argues that, “[d]ecoupling human well-being from the destruction of nature requires the conscious acceleration of emergent decoupling processes.” This strategy, which is broadly shared (14, 19, 21, 42, 64), pins future sustainability squarely on the shoulders of decoupling economic growth from environmental impacts through technological innovations that support efficiency improvements (particularly in energy and food systems) (27).

Our track record of progress in efficiency gains over the past 30 years highlights that current rates of efficiency improvements are insufficient to ameliorate the environmental impact entailed by increases in population and consumption levels (10). As just one important example, since 1990 increases in carbon intensities have declined by 0.7% per year, while populations have increased by 1.3% per year and real incomes by 1.4% (1, 42). Similarly, though improvements in material intensities may have *mitigated* impacts, absolute global materials use still increased by 56% from 1995 to 2008 (43). We have not seen absolute reductions in environmental impacts (65), nor has there been much evidence to date for significant relative decoupling (40). Population growth and increases in affluence (and consumption) are simply overwhelming efficiency improvements (1, 40, 42, 43, 66).

The Copenhagen and Cancun summit goals of keeping global average temperature rise below 2 degrees roughly translates to holding atmospheric carbon levels at or below 450 parts-per-million (1, 67). To accomplish this, the IPCC states that emissions need to be reduced between 40 and 70% by 2050 compared to 2010 levels and achieve net zero emissions by 2100 (65). Another estimate calls for emissions reductions of more than 80% by 2050 (42), which translates into carbon intensities almost 130 times lower than today (1)—essentially Factor 100 improvements. Whichever calculation we choose, many researchers now agree that with current trends in population and consumption growth, decoupling economic growth from even just greenhouse gas emissions² will require much faster resource intensity reductions per unit of GDP (1, 6, 14, 22, 42, 68).

Rebounds and unintended consequences. Gains in efficiency not only need to increase in rate and quantity, but also in resiliency. Research has demonstrated that efficiency gains may be subject to rebound effects, whereby increases in efficiency actually lead to increases in product use, which dampens or even swamps efficiency benefits (42, 69). These types of unintended consequences can lead to an overestimation of the benefits of innovations focused on efficiency. York et al. (2009) documented that in “four major economies (US, China, Japan and Indonesia), increasing eco-efficiency was associated with increases in total levels of consumption over four decades” (40). Although this literature is contested, a growing body of evidence suggests that rebound effects can limit benefits to only 30–60% of theoretical potentials (19, 40, 42, 70–75).

Similarly, there appears to be a certain efficiency myopia. Benefits are expected in engineering estimates—the accepted form of modeling benefits—to accrue to one sector or product, but not impact the broader economy. Income effects, where income saved through efficiency in one area is spent in another part of the economy (70, 76), are one example where important system effects may not be properly accounted for. Moreover, although many companies are developing more efficient products and practices, core incentives remain to sell more products, not reduce absolute impacts. Still other times, the efficiency myopia permits innovations to fail to target the three main impact areas of consumption (22)—transport, housing, and food—which drive 70 to 80% of environmental impacts (52, 72). Finally, efficiency narrowly defined may end up *shifting* burdens onto other environmental issues (42), while failing to address root drivers (42).

A Focus on Strong Sustainable Consumption

Focusing entirely on decoupling avoids examining how current lifestyles and systems generate significant environmental and social problems. The decoupling framework fails to understand complex systems of production and consumption, thereby allowing for an inappropriate amount of substitutability amongst economic, ecological, and social resources and benefits. Efficiency strategies alone often ignore issues of equitable distribution and development (an issue we discuss later), while distracting from a needed focus on absolute reductions in environmental impacts. To be clear, efficiency measures are an absolutely necessary part of an effective strategy. Yet, efficiency *alone* fails to effectively address the scale and scope of our consumption and sustainability challenges.

A growing and diverse group of academics and practitioners has emerged recently, calling for *strong* sustainable consumption. This line of research advances a pre-analytical framework that conceives of the economy within society within the environment (77). This framework is

²Not to mention loss of biodiversity, eutrophication, etc.

systems-based, thus strong sustainable consumption research aims to examine the tensions between ecological, economic and social priorities, and seeks to develop strategies that balance aims of efficiency, sufficiency, and resiliency.

This basis has led researchers to examine current power structures (78), directly questioning levels and forms of affluence, advancing more equitably distributed consumption in addition to technologically improving the efficiency of consumption (1, 19, 66, 68). The diverse group of scholars identifies reforms and processes to address unsustainable consumption from a systems perspective. Thus, although like weak sustainable consumption they focus on the most environmentally impactful areas—transport, housing, and food—their research yields distinct policy insights that diverge from technology-focused innovation. They advocate for social and political processes and innovations to assist rapid decreases in private automobile use and meat consumption (44, 79); transit-oriented development; decreased food waste; increased recycling, repairing, sharing, and reuse of goods (67, 79, 80); and equitable levels of consumption in the developing world (18, 81).

FROM INDIVIDUAL TO STRUCTURAL CHANGE

As more researchers in the sustainable consumption community have come to share the need for *strong* sustainable consumption, the issue of how to achieve such changes in a politically, socially and economically viable manner has become a central research topic (78, 79, 82, 83). A system of strong sustainable consumption is a difficult proposition in a society presently focused on growth in consumption. Economic progress is thoroughly embedded in social norms, personal habits, individual decisions, power structures, laws, and cultures. Thus, strong sustainable consumption researchers argue convincingly for a fuller understanding and appreciation of the logics and decision processes of the actors—consumers, business, and government—and the systemic nature of so-called lock-in of unsustainable activity. With this knowledge and framework, we can design more effective and resilient interventions or processes to support a transition to truly sustainable consumption (81, 84).

Individual Logics

Mythologized as rational and utility maximizing in economic theories, individuals' consumption habits are in reality motivated not just by personal needs for food, clothing, housing, and transport, but also by desires for novelty, status, social comparison, and respect (1, 85). Products become part of the so-called extended self, communicating to peers and society about identity, affiliations, and ideals (1). Although some consumption is certainly about meeting basic needs, it also represents a system of status, meaning and cultural connection (1). Evidence is now clear that this so-called positional consumption can create a self-perpetuating cycle (86, 87), where increasing levels of consumption become normalized, and further consumption is then necessary to keep up or stay ahead. Individuals who do try to shift from consumerist lifestyles experience significant financial, emotional, and social conflict, in part due to a lack of tangible alternative lifestyle options that deliver equivalent status, self-worth, etc. (1, 88, 89).

Changing individuals. Supported by analysis primarily based in market research, consumer surveys, and focus groups, past strategies to change individual behavior have centered around information provision. Researchers reported that a majority of consumers would like to purchase greener, healthier, and more sustainable products. A central puzzle in this research has been that consumer purchases consistently deviate from their reported sustainability preferences. This is

referred to as the attitude-behavior gap (90). We now know that information provision strategies have largely been unsuccessful at closing this gap (91, 92). In response to findings on the limitations of information provision, behavior-based sustainability research has tried to more fully understand consumer decision-making processes.

Several insights into decision-making have emerged from consumer behavior, social psychology, and behavioral economics research over the past twenty years. A now well accepted conclusion of this research (93, 94) is that individuals are not fully rational actors (partly explaining the ineffectiveness of information provision). Instead, consumer decisions are contextual and affected by psychological processes (or cognitive biases) such as habit, social norms, bounded rationality (where decisions are limited by our own cognitive limitations and information access), loss aversion (where people fear losses much more than gains), cognitive depletion (where we have a limited pool of self-control and willpower), temporal constraints (where time pressures distort decisions), anchoring (where a first piece of information can bias a decision), and peer influence, to name just some of the most important (95). Through trying to understand the predictable irrationalities of consumers (96), behavioral interventions such as choice editing (where the range of choices is actually reduced) and smart defaults (where the default option is the most sustainable or healthy choice for people) have been developed that aim either to limit cognitive bias or to utilize bias to drive sustainable action.³

Individuals have competing concerns and pressures in the marketplace (98), limited time to make decisions, and limited information about the impacts and options for action. Several behavioral interventions have been designed to respond to these constraints. The most prominent such example involves eco-labeling efforts that aim to create simple, salient indicators for decisions. To date, although eco-labeling has grown in numbers and product category coverage (some estimates are that there are now more than 400 eco-labels in the United States and Europe), it has had fairly limited impact on mainstream consumers or mainstream brands and products (99–101). Eco-labels can be effective and are needed; however, they need to be better integrated and contextualized within complex decision-making environments of mainstream consumers (92, 102, 103).

Sustainable consumption information ideally should be tailored to the situation and individual (104), as well as framed saliently and concretely (103). Choice editing—a strategy now employed by some retailers and employers—can frame a decision such that individuals are more likely to choose the sustainable option. Creating a sustainable default option can effectively utilize status quo bias (where people prefer to buy the “normal” product) (92, 105, 106), without restricting choice—a key goal of policymakers. Similarly, anchoring (where information is presented carefully to frame poor options and guide people to better options) can be employed, such as in a rating system or pricing scheme (92).

As mentioned, one common motivator for consumption is social concern for status. Thus, a promising area of behavioral interventions involves a focus on social influence (107). Invoking descriptive norms—what “others are doing”—can have a significant effect, although this could cause regression to a less impactful mean (92). Invoking injunctive norms—what people “should do”—also shows potential to move people in a positive direction (108). Interventions ideally should be delivered via friends, family, peer groups, or trusted intermediaries (such as NGOs or celebrities), depending on who is trusted and with whom specific groups of people identify (104, 107). However, even situational cues connected to social norms may not be able to counter competing concerns and norms (109, 110).

³For policymakers in particular, these decision-making insights can be useful to avoid policy failures stemming from implementation, procedural, and acceptance issues (97).

Social influence research is still uncertain about when it leads to a kind of herding versus to more transformative social learning (107). Although herding can be useful in situations of uncertainty or crisis (97), social learning is important for longer-term norm creation (105, 107, 109).

Providing feedback on actions can also help overcome a lack of information on the efficacy and impacts of consumer choices. Similarly, providing feedback on the actions of others can be useful to demonstrate shared responsibility and social norms (97). Yet feedback is often presented in tandem with rewards, either economic or status-related. These rewards may increase the salience of individual and economic motivation, thereby impeding long-term efficacy of interventions and crowding-out other-regarding behavior (104). Rewards might still be considered for sufficiently large gains from one-time events (such as the purchase of an electric vehicle or roof-top solar installation).

To complicate things further, most situations encounter multiple biases, demonstrated by research that has shown that one-dimensional interventions often produce marginal benefits compared with synchronized treatments (111). Thus, synchronized treatments need to be studied further. Although this adds to the complexity of any intervention (112), it ultimately will benefit the efficacy of integrated policies (97).

Furthermore, due to the complexity of behavioral interventions, a key goal of behavioral research has been to identify interventions that persist or spill over into other behaviors (108). Research on habit formation has shown potential—via “if, then” plans applied at “moments of change”—to create new behavioral patterns (104, 113). Current research, however, is divided on the impacts of so-called catalyst behaviors (19, 91, 104, 114). For instance, if actions such as recycling are simply perceived as household routines (not connected to environmental values), then spillover is unlikely (108). Status-based interventions may also generate internal and external spillover due to identity formation, peer effects, and social norms.

Limitations of individual behavior change. Most individuals in the developed world currently consume beyond sustainable levels (90, 104). Even individuals who conceive of themselves as environmentalists and conscious consumers still make unsustainable choices (71, 108).

This disconnect can be attributed in part to the tendency of some behavioral interventions to be in direct competition with billions of dollars in marketing from corporations (87), rapid product obsolescence, easy credit systems that encourage debt-driven spending (87), transportation infrastructures that incentivize single-occupancy vehicle transit, work dynamics that encourage consumption, and prices that make it more affordable to purchase less sustainable options (86, 113). Governments further spur consumption spending through tax policies, price controls for food, transport and consumer durables, trade agreements, monetary policy, as well as subsidies for resource extraction and manufacturing.

Moreover, consumerism is the dominant economic and cultural paradigm of the 21st century. Greater division of labor and longer work hours incentivize consumption instead of nonmarket, household, or do-it-yourself activity. Work-life culture is increasingly a work-consume culture (115). Technological innovations are increasingly geared toward facilitating consumption nearly anywhere, anytime. Abstract notions of success and progress are defined economically, and the media cite GDP and stock market indices as measures of daily progress and stability. As Assadourian (116, p. 115) argues, this deep culture of consumption “stems from decades of engineering of a set of cultural norms, values, traditions, symbols, and stories that make it feel natural to consume ever larger amounts—of food, of energy, of stuff . . . and over time ‘consumers’ deeply internalized this new way of living.”

Due to the multiplicity of influences on consumption, a narrow approach to change consumer behavior appears to be a weak lever (117, 118).

Integrating Behavioral and Structural Change

If we take an integrated understanding that actors and their behaviors are conditioned by one another and also by the structures they inhabit, we are compelled to develop more comprehensive solutions that embed multiple behavioral interventions within broader structural reforms.

Interesting research has begun to emerge in this area of behavioral-structural integration, and provides useful insights into novel social and market developments, such as the collaborative and circular economies (34). In particular, research has shown that structures—markets, institutions, and policies—impart norms and values (119–121), and thus more than providing pathways of action, can generate feedback loops of learning (122). Indeed, collaborative economy researchers have focused a fair amount on the values of the movement (123, 124). Research has hinted that individuals who participate in novel economic arrangements are likely to become politically engaged when their mode of living conflicts with traditional powers (68). Moreover, certain ecologically minded consumers are beginning to position their actions as part of collective processes, asserting that truly sustainable lifestyles necessitate political and collective decisions (125).

Behavior Change of Structural Actors

Effective sustainable consumption—that addresses environmental, social, and equity issues—likely requires addressing unsustainable infrastructures and institutions of consumption (19). Thus, we need to understand why certain infrastructural and institutional decisions are made and attempt to influence those decision processes. One path that has been studied seeks to apply behavioral insights to changing corporate and government practices around consumption, with the goal of motivating sustainable products, services, institutions, and infrastructures.

Business Logics

Companies are under intense pressure to continuously grow revenue. Wall Street's focus on earnings growth means most firms are locked into a cycle of competing to increase the throughput of products and services as their core strategy to grow sales and earnings. Shareholders demand profit-optimizing, risk-minimizing strategies, even if they require externalizing costs (3).

Changing business. Researchers have begun applying behavioral psychology to changing corporations; however, this is less developed (97). Although business processes tend to obviate individual irrationalities, there are biases that underlie corporate dynamics and patterns, such as status quo bias, inertia, routines and bureaucracy, satisficing (rather than profit maximizing), loss aversion, risk aversion, and reputational concerns. Understanding these biases and designing targeted interventions can help to advance business model experiments that focus on longer time horizons and that direct competition and innovation engines on solving sustainability challenges.

Initial research suggests that invoking risk (126, 127) may be a key lever to change business as the discussion over stranded assets in fossil fuel portfolios and climate risks for global firms demonstrates loss aversion concerns (128). Risk to a firm's reputation, supply chain, and market might also push companies to develop more sustainable processes and products (129), which then might cause them to support more stringent regulation that gives them a comparative advantage. Furthermore, pressures by external stakeholders, which create reputational risks for individual employees and which target relational and moral considerations of company leaders, seem effective in motivating firms to change.

Another key sustainability intervention may be to develop and enforce sustainability reporting and accounting, or environmental profit and loss statements. Several prominent firms have begun

voluntarily producing serious sustainability reports. The US Securities and Exchange Commission has begun requiring disclosure of environmental liabilities. However, more stringent implementation of reporting will require businesses to internalize externalities and optimize production with respect to resource depletion and environmental concerns. This would also help alter the accounting methodologies used by businesses, changing which decisions look good on paper, thereby changing risk profiles (97). With integrated metrics and greater transparency in reporting, public perceptions and impact investors could apply pressures to motivate firms to align business with environmental goals (130).

Recent legal developments—such as the creation of benefit corporations—also seek to support and shield sustainability-minded companies from shareholder profit maximization pressures (131). These changes hold the potential to align high-level sustainability goals with internal corporate decision processes, a place where more research is critically needed.

Government Logics

Governments similarly have significant challenges to break from biases toward consumption growth (28, 132). Consumer-led economic growth is a dominant paradigm from the United States to China to the poorest countries in the world. Government institutions depend on taxes generated via consumption, with one of the most glaring examples being sales taxes supporting state and local government agencies. But more than just filling public coffers, geopolitical power (3), economic and social stability (1, 133, 134), poverty alleviation (12), and even social progress (135) are largely considered dependent on economic growth.

Changing government. Governments, of course, have their own internal dynamics, bounded rationalities, self-interested individuals, political battles among competing interests, bias toward short-term social stability (and re-elections), myopia, inertia, and lack of accountability (97, 136). Several researchers have proposed more transparency and participation within policy processes (77, 81, 97) as strategies to at least partially ameliorate problems of public accountability and regulatory capture. More research is needed to assess how these strategies might affect preferences, attitudes, and values of government officials.

New metrics of progress and development may be key to help governments break from consumption-biased decision processes (137). If the public assesses policymakers in part by the rise and fall of indicators such as GDP, then new metrics such as the Genuine Progress Indicator (138), the Index for Sustainable Economic Welfare (139), combined biophysical and social indicators (121), and the Gross National Happiness (GNH) Index (140) may enable governments to demonstrate progress while advancing transformational policies.⁴ Although there is significant variance between these metrics, for the most part, they explicitly include values for inequality, biodiversity, and greenhouse gas emissions. In this way, short-term concerns can be more effectively balanced so long as there are clear metrics for long-term goals for which governments can be held accountable. Moreover, these new measures enable policy comparisons that can assist public communication and adaptive governance (121). That said, much research is needed to resolve difficult variable-weighting issues as well as to make these indicators more actionable for policymakers. Although we have seen several governments begin to experiment with tracking “happiness,” “well-being” and sustainability alongside GDP, we have not seen these measures

⁴A more limited yet still impactful shift has been the social cost of carbon, which has helped usher in environmental policies in the United States that might have otherwise failed standard economic cost-benefit analysis (141).

Table 1 Cognitive barriers and interventions in systems of consumption and production

Actor	Cognitive barriers	Key interventions
Individuals	Bounded rationality, loss aversion, habit, social norms, peer influence	Simplification, smart defaults, social influence, feedback, structural change
Business	Status quo bias, risk aversion, satisficing, reputational concerns	Stakeholder pressure, public-private partnerships, new metrics, internalizing externalities, new business models
Government	Bounded rationality, political battles, myopia, short-term bias, lack of accountability	Transparency, participatory democracy, new metrics of progress

connect deeply into policies and practices (136). Moreover, there are still challenges in measuring qualitative issues such as “well-being” and “flourishing” (15, 139).

Table 1 presents some of the key barriers and interventions currently being tested to shift the practices of individuals, corporations, and governments around the world.

Changing Culture

System changes for sustainable consumption will likely co-evolve with culture changes. As-sadourian (116, p. 113) argues that our “norms, stories, rituals, values, symbols, and traditions” influence nearly all of our life choices, in part by being codified in our public and private institutions. Thus, culture change can be seen as a by-product of and influence on changes in actors.

Many researchers have come to the conclusion that an integrated vision is critical for the success of a postconsumerist society (19, 55, 82, 142–145). This vision, with a reconstruction of understandings of wealth, affluence, and the “good life,” needs to be codified in dominant societal institutions “to normalize an alternative set of practices, values, beliefs, stories, and symbols” (116, p. 119), and to serve as a guide for new lifestyles and infrastructures. Indeed, current practitioners—individuals, businesses, NGOs, and governments—need the support of a unified community collectively addressing broader principles (19, 35). Some research has pointed to the ability of influential leaders (146) or of institutional codification (116) as effective methods of disseminating alternative narratives. However, research is still needed on methods to effectively spread alternative narratives to actors locked into consumption paradigms.

For guidance, we might look to certain niche contexts, where the codification of alternative narratives has been effective. The inclusion of “Buen Vivir” or “good living” principles into the national constitutions in Ecuador and Bolivia has given a novel cultural framework that redefines affluence and creates a legal basis for sustainable development (147). Similarly, the development of the GNH Index in Bhutan has been surprisingly influential as a guide to an alternative development paradigm (140). Although western countries may be far from creating rights for nature (116), the French, British, German, Canadian, and Chinese governments have all followed Bhutan’s lead and begun to incorporate measures of well-being into their national assessments (140). These codifications can signal to businesses, individuals, and communities that sustainability implications should be part of standard decision processes (116).

ACHIEVING SYSTEM CHANGE

Vitality, researchers are realizing interventions need to be connected to a coherent, comprehensive strategy that addresses both scale and scope. This requires a more complete understanding

of system dynamics—actor roles, relations between actors, and relationships with dominant structures—and methods to address those dynamics—behavioral, structural, and institutional interventions, at key leverage points—to break from unsustainable processes and to generate positive sustainability feedback loops (148–150). An emerging research area of complex adaptive socioecological systems might provide insights to identify key leverage points and understand connections between actors, norms, rules, and other system dynamics (151). Though it may be impossible to characterize comprehensively, better modeling of system dynamics can help actors identify the most effective, efficient, salient, and key leverage points. Donella Meadows’ (146) elucidation of places to intervene in a system is a foundation for this type of analysis.

Research shows interventions and transformations occurring at one level can affect other levels (almost simultaneously) (9, 149, 152). Regulation and new analytical frameworks support sustainable forms of PSS and novel business models (30, 34). Stronger social programs and better city planning enable reduced consumption lifestyles (153, 154). NGOs offer “transparency, accountability and expertise” (155, p. 672) to implement strong policies and regulations, and identify policy windows that allow sustainability niches to be advanced (156). Social movements advance policies through pressure on governments (149). Urban areas can test innovations at multiple scales (157). Individuals collaborate in governance through citizen science, normative discussions, consumer policing, and social innovations such as resource sharing (1, 120, 158). Moreover, bottom-up efforts can support culturally appropriate, resilient, and adaptive governance systems by providing templates for system redesign (36, 159). More research is needed to develop clearer and more effective policies involving infrastructure, norms, and regulations.

System Dynamics in a Transition

Over the past 20 years, sustainability transition studies have sought to better understand and facilitate efforts to transform sociotechnical and/or socioecological systems. A central finding has been that transitions are long, complex, and uncertain processes (149, 160) that involves learning, coevolution, and adaptation at multiple levels (161, 162). Sometimes framed through niche-regime interactions (163), transition studies explicitly look for pathways to develop small technological or social innovations from market niches into fuller regimes.

Given national and international political gridlock around sustainability issues, many researchers have instead analyzed the effects of less powerful actors—civil society, social movements, entrepreneurs, city and regional governments—and the potential of bottom-up transitions as a means of achieving significant change (82, 159, 164, 165). As just one example, developments in the food sector provide a range of niche innovations such as permaculture, pasture cropping, integrated farming, “slow food,” community-supported agriculture, and farmer’s markets (36, 118, 153). It is of course not clear that a sustainable and equitable society can be built through bottom-up measures alone. For one of these niches to eventually become a regime, it must be scaled, replicated, and diffused across spaces, cultures, and institutions (165, 166).

This complex dynamic makes initiatives such as collaborative consumption and the circular economy difficult to fully appraise. They are likely important and needed components of sustainable systems. However, at this point, it is not clear they are truly sustainable. They are important, nonetheless, as they offer alternatives to traditional consumptive practices and a growth economy (34, 35).

We need to move beyond case studies toward a coherent framework and adaptive plan for sustainability transitions. Research and practice should focus on developing, testing, and analyzing multiple transition pathways (126, 149, 160), identifying and developing strategies for adaptive collaborations while taking into account competing interests (149), and more effectively invoking

positive and negative feedback loops between actors, structures, institutions, and norms (150). Ultimately, the transition to significantly more sustainable systems must be supported by the coordinated actions of city, state, and federal policymakers (52), as well as nonstate actors, each focused on processes of learning, iteration, and scaling.

A multilevel, niche-regime framework (161, 167) provides a lens for scaling innovations (168). Government agencies, NGOs, and firms need to focus on both the internal processes of niche development and the external processes to support, learn from, and advance new systems of consumption and production. Roles include managing public expectations, advancing supportive and reinforcing structures and institutions, creating support and learning networks (120, 159), and accumulating and sharing financial and intellectual resources (149). Governments in particular can advance policies—such as the elimination of subsidies for existing unsustainable regimes, stricter regulation of dirty industries, taxing pollution, etc.—while investing in research and development for sustainability niches. Governments can also reduce risk for innovators, procuring sustainable innovations, and advancing transparency and public participation in policy setting, potentially through new metrics of progress. These processes require active coordination and intervention at multiple levels by diverse stakeholders to identify and overcome infrastructural, behavioral, economic, and institutional barriers to niche development (148), while creating structures and institutions that support and reinforce positive processes.

Economic Transition Strategies

When strong sustainable consumption strategies are discussed, there is an almost palpable fear that efforts to transform or decrease consumption will have calamitous economic and social impacts. Our economy seems to be built as much on aspiration, striving, and rewards of affluence as it is on fear, insecurity, and threats of poverty. In the current economy, it is easy to understand why any move to slow consumption or economic growth would be viewed as illogical, if not antithetical to so-called progress. For governments, corporations, and ultimately individuals, a slow or no-growth economy holds the potential for disaster (169) via a downturn in profits, stock prices, employment, taxes, government spending, and debt repayment.

A small group of academics has taken on this line of reasoning and resistance to sustainable consumption. Initial modeling shows that with planning, and step-wise processes, it may be possible to reduce consumption without creating the negative spiral mainstream economists and politicians fear, in essence, decoupling the resiliency of the economy from economic growth (170). One key policy involves gradually stepping down consumption with production, then creating systems of work sharing, to protect against increases in unemployment (6, 133). Peter Victor's (6) model of the Canadian economy under a planned degrowth scenario shows that with several key policies, such as a gradual work hour reduction to 25% of current levels alongside a substantial carbon tax, unemployment, poverty, and the debt-to-GDP ratio can actually decrease. Contrary to recent research by Piketty & Goldhammer (171), slow to no-growth scenarios need not produce more inequality and can in fact, with regulation, lessen inequality (172). A key relationship here is the elasticity of substitution between labor and capital (172), although more modeling and theory are needed to understand whole economy effects (67). In theory, productivity improvements from innovation can be rewarded with reduced work hours and then reduced consumption (133, 173).

Sustainability transitions, despite lower per capita incomes for individuals in developed countries, do not need to adversely affect well-being. This outcome can result partly from non-welfare-reducing or cash-positive environmental actions (52, 174), and partly because well-being is determined by more than just income (136). Changing consumption patterns, when done right, may offer a so-called double dividend of environmental and social benefit (1). Encouragingly,

Druckman & Jackson (79) were able to map out a reduced consumption scenario that meets key quality of life criteria at a level of greenhouse gas emissions 37% lower than 2004 UK per capita levels.

We also need to consider the distributional effects of policies that seek to change consumption. Policies should ensure low-income groups are not harmed in such a transition. Several researchers have called for some form of redistribution as key to equitably reducing consumption levels (18, 19, 81). This may entail the provision of a basic income, taxes that essentially lead to a maximum income, the full pricing of environmental externalities, and taxation of luxury and positional goods. More broadly, nonmarket and nonstate efforts could be analyzed for contributions toward community resilience, local provisioning, personal fulfillment, and ecological sustainability.

Crisis-Driven Transformation

Given the current political climate—from Washington to Beijing to the halls of the United Nations—it seems unlikely that government actors will initiate needed policies to foster a sustainable consumption transition. However, as the so-called Great Recession of 2008 showed, crises beyond the control of government actors, whether another global recession or a water or climate crisis, may drive large-scale change in consumption practices (144). Shocks can also cause reflection and higher-order learning (175). It is thus critical to have policies and programs ready when policy windows open. This is not the ideal scenario. However, it may be the most likely to motivate government action (170).

Reforms will need to take into account potential issues with refugees, resource conflicts, and other extreme scenarios. At the micro level, local networks and city policies can help regions prepare for and flourish in times of scarcity. Recently, resiliency has become a central concern of city planners and funders [such as the Ford Foundation (<http://www.fordfoundation.org/issues/metropolitan-opportunity/just-cities>) and Rockefeller Foundation (<http://www.100resilientcities.org/>)]. At a macro level, focus should be on policies to prevent crises and to support adaptive governance (19).

Equity, Development, and Leapfrogging

Whether crisis-induced, or planned, the path toward sustainable consumption must be centered around commitments to equity, inclusion, and just transitions (176). The poorest in the world, and even the poor within rich and middle-income countries, must not be punished in the transition to sustainability. In fact, if we are to continue any form of consumption-led growth, it should focus on the consumption of basic needs: safe housing, healthy food, clean water, etc. And simultaneously, any reductions in production should be implemented with an eye toward development and employment impacts on the poor, and their need to develop robust and resilient economic systems.

Economic development, poverty reduction, inequality, and sustainability are deeply interwoven (81, 153, 177). As one very small piece of this, the use of territorial-based emissions accounting in international agreements has allowed developed economies to claim decreased emissions intensities when reductions mainly resulted from the off-shoring of carbon-intensive industries (11). Besides the inherent inaccuracy in accounting, this offshoring also exacerbates inequity by allowing greater consumption in rich countries while driving environmental degradation through resource extraction, water depletion, deforestation, soil erosion, biodiversity loss, and pollution in poorer countries (178). A shift toward consumption-based accounting of emissions is a step toward greater accuracy and international equity (179, 180).

Moreover, although the majority of reductions should come from developed countries, emerging middle class consumers in developing countries will be critical to meeting sustainability targets.

Developing country investments in infrastructure are critical for environmental impact reductions (14, 42). As China and India's growth, powered in part by coal, continues faster than global growth, emissions intensity reductions may be swamped (42, 65). The most hopeful scenario may be for developing countries to leapfrog western development, and to develop energy, socioeconomic, and infrastructural pathways that avoid unnecessary externalities (160, 177, 181). The aim should be for equitable consumption within overall sustainable levels (81).

Toward Postgrowth New Economics

Ultimately, the consumption-sustainability dilemma leads us back to the challenge of providing viable alternatives to consumption-led economic growth (182). The new economics, degrowth,⁵ and postgrowth movements have come the closest to idealizing integrated transformations that build off behavioral, cultural, and systems insights, with the goal of significantly changing transport, housing, energy, and food systems (68, 182, 183). Drawing from the idea that unsustainability is a crisis of the entire socioecological system (184), these movements aim to develop qualitatively different systems that are centered around resilient societies operating within ecological limits. They call for principles of ecological and social responsibility for all actors, scale-matched governance for efficient action and integration across these scales, use of the precautionary principle, adaptive management, full-cost accounting, real democratic participation (77), and an eye toward equity and intergenerational justice (185). Importantly, they try to break from "eco-bourgeois" perceptions toward frames that are agreeable to middle class aspirations (186). This is key, as it is clearly different to choose a reduced consumption lifestyle than to be forced into one (154, 187).

Unfortunately, many academics and practitioners in this movement currently fail to connect with other actors across issue areas (150) or lack perspective on systemic interconnections. There is a need for more thorough appraisal of new economy initiatives, moving from specific case studies to integrated systems-level analysis of changes, understanding potential feedback loops, risks, barriers, and side-effects (45, 150). An ecological macroeconomics currently in development will be helpful to allow practitioners to situate their actions within a broader framework, as well as to enable policymakers to create appropriate policies, institutions, and infrastructures to support transitions (172, 188). At this point, the postgrowth literature still has much work to do to develop and coordinate actors within a broader vision of system change (121, 150, 182).

CONCLUSIONS

Given current trajectories of population and consumption growth, it is clear we face impending sustainability crises. Advances in industrial ecology, life-cycle assessment, and environmental sciences have helped to identify our greatest impact areas: energy, transportation, housing, and food systems. However, current efforts that focus on efficiency and market-based solutions are insufficient to solve even our climate change challenges, let alone account for intergenerational sustainability and equity. Truly sustainable consumption entails moving from efficiency improvements to lifestyle changes, to broader culture changes, to sociotechnological system changes.

Proposals for Factor 100 decoupling, 100% renewable power for transport and housing, and rapid decreases in the use of private automobiles, meat consumption, etc., will likely require a move

⁵Although not particularly appealing or accessible as a concept, the degrowth movement has fostered a robust academic literature, complete with international conferences and a recent book (although interestingly, the book does not include a chapter on consumption).

to more equitable forms of consumption, postconsumerist institutions, structures, and cultures, and postgrowth economics. The pathway to these transformations requires new frameworks, tools, and interventions for transitioning to and then sustaining future systems. Diverse fields of research—from social psychology to ecological economics to sustainability transitions—now point toward new theories, policies, and innovations for transforming consumption and production. These literatures and practices need to be further developed, and then integrated, tested, and implemented. Deep system change is likely only possible if we view interventions and actions through an integrated lens of behavioral, structural, institutional, and cultural change, and then situate these changes within a systems framework for learning, iteration, and scaling.

Ultimately, if we are serious about sustainable consumption, we will need to develop and test a coherent package of integrated, adaptive, and reinforcing policies that address individual cognitive biases as well as deep infrastructural systems, and that support a scalable transition toward real prosperity, equity, and environmental sustainability.

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