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The appeal of the circular economy revisited: on track for transformative change or enabler of moral licensing?

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The proposal of an economy that is circular and without the need for material or energy input has an irresistible appeal to those who recognize the precautionary concept of planetary boundaries and acknowledge that resources are limited. Thus, in the public discourse, its narrative outperforms other lines of arguments when it comes to keeping radical critics of destructive extractivism and the growth imperative in check and averting discussion of degrowth, post-growth, or other systemic alternatives by larger segments of the population and government bodies. Moreover, the myth of a circular economy has the additional benefit that it can win over parts of the environmental movement that is apprehensive of radical and transformative change, particularly in the urban milieus of a middle class that enjoys the privileges of the current social order. In this paper, I argue that the circular economy narrative tends to hinder the necessary systemic transformation while entailing a wide range of specific measures that deserve to be recognized for their merit.

Introduction

Now that the narrative of recycling has lost its luster, the circular economy has become the new buzzword for sustainability advocates. After decades of promoting reuse and recycling, a growing amount of waste ended up feeding into a flourishing recycling industry without tackling the problem of production-associated emissions or increased consumption of raw materials (Alfredsson et al., 2018). In contrast, a sustainable and circular economy would allow a progressive reduction in resource input by creating closed loops, guaranteeing the well-being of future generations, while creating jobs and saving energy (Geissdoerfer et al., 2017; Stahel, 2016). This proposal was also picked up by political actors like the European Commission which framed the circular economy as a regenerative growth model for a sustainable economic system (European Commission, 2020), a framework which however has been criticized as inconsistent and imprecise on the ground that it does not reckon with the inability to use natural resources many times over without the need to extract them anew, and thus struggles with a low degree of circularity (Kovacic et al., 2020). On the backdrop of unabated man-made climate change (IPCC, 2023), deteriorating biodiversity and ecosystem functions (IPBES, 2019), and the coming of a new geological epoch termed the Anthropocene to substitute the relative stability of the Holocene (Crutzen and Stoermer, 2000; Steffen et al., 2007),

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it must be discussed if the circular economy proposal will entail sufficient transformative change of the existing socioeconomic metabolism which is indispensable to overcome the current conundrum (Krausmann et al., 2018). Furthermore, I argue that the apparent logic and beauty of the circular economy concept indeed obfuscates the need for a radical reduction and redistribution of energy (Millward-Hopkins et al., 2020) and overall consumption (Wiedmann et al., 2020), including the renunciation of continued exploitation of raw materials from formerly colonized geographies (Alcoff, 2022) that upholds an unsustainable 'imperial' mode of living (Brand et al., 2017).

Even if not endorsed by classical economic theory, economic activity operates within the natural environment and is subject to the laws of nature that set limits to human endeavor. Without naming the proposal of a circular economy explicitly, Boulding (1966) introduced the concept of the Earth System as a closed loop where material entropy that occurs outside of natural processes can only be countered by constant energy input. Yet, under the premises of the Laws of Thermodynamics, the energy contained in a closed system is unchangeable, and irreversible spontaneous processes will increase entropy in the sense of homogeneous distribution of energy or matter to a maximum (Sandler and Woodcock, 2010; Starikov, 2021). Drawing on these considerations, the economist Nicholas Georgescu-Roegen scrutinized the relevance of the Second Law of Thermodynamics (the Entropy Law) for the economic process and emphasized that it operates on a unidimensional timeline where energy is dissipated and natural resources are depleted, which renders a growth economy, or even a steady-state economy, impossible in the long-term (Georgescu-Roegen, 1971).

The ideas of Boulding and Georgescu-Roegen inspired the concept of Degrowth that proposes a radical transformation of the societies in the global North to reduce their ecological metabolism and resource avidity (Bonaiuti, 2018; Kallis et al., 2012, 2018; Kerschner, 2010). While critics observe that Georgescu-Roegen might have misinterpreted the Second Law of Thermodynamics drawing an improper analogy between the entropy of energy and the entropy of material substance, his work is still a valid contribution to the economic discussion about the theoretical impossibility of full recycling due to the distinction between stocks—non-renewable in any circumstances—and funds which are renewable if exploited at a sufficiently low rate (Khalil, 2004).

Envisioning a circular economy and the concept of the *perpetuum mobile*

When Leonardo da Vinci postulated the impossibility of a *perpetuum mobile* within the physical conditions of planet Earth (Bera, 2021), he could not have imagined that a similar concept would be resurrected five centuries later. But the ancient dream of humanity to create an apparatus that would work incessantly without the additional input of human labor, or an external source of energy or material, awoke to new life: the congenial concept of a circular economy promises to transform waste into wealth and to warrant the pursuit of exponential—yet sustainable—economic growth forever. But while the idea of a circular economy has become increasingly popular, it still draws, albeit not explicitly, on prior concepts of industrial ecology and industrial symbiosis that support the sustainable development agenda (Cecchin et al., 2021).

Before the industrial revolution set off, global economic activity was almost entirely circular but the advent of mass production and the increasing use of fossil fuels that promoted more effective extraction of other natural resources transformed circularity into a linear process that started to deplete natural resources and created large amounts of waste (Bali Swain and Sweet, 2021). More than 50 years ago, the report on the *Limits to Growth*, commissioned by the Club of Rome and compiled by a team of international scientists at the Massachusetts Institute of Technology (Meadows et al., 1972), unmasked the unsustainability of the make-use-dispose process of the linear economy, and it became necessary to create a renewed public perception regarding waste management and resource use (Blomsma and Brennan, 2017), if the fundamentals of the capitalist economy were to remain unquestioned. Hence, framing waste as a resource (Zaman, 2022) not only created the opportunity for collective action and research, based on an experience of shared ideas and values but also granted the possibility to encompass resource use and waste production within the limits of the current economic system.

Scrutinizing the circular economy and conceptualizing it as an umbrella concept that connects previously unrelated constructs to create a new paradigm, can create an understanding of its consolidation as a new narrative that is characterized by continuing to branch out and becoming more and more complex over time (Blomsma and Brennan, 2017). As Hirsch and Levin (1999) point out, an umbrella construct can be particularly useful in fields that lack a solid theoretical background but where its validity tends to be less challenged by a nonacademic constituency. Understanding the circular economy as an umbrella concept could therefore contribute to decoding the popularity of the circular economy proposal, despite its shortcomings and inconsistencies that have been detailed.

In their revision of the circular economy concept, Kirchherr et al. (2017) mustered a plethora of 114 definitions which in itself illustrates its heterogeneity and the need to resort to frameworks like the umbrella concept to maintain the notion of a coherent explanatory model. After an iterative coding process that embraced 17 dimensions, the authors came up with a definition of the circular economy as "*an economic system that is based on business models which replace the 'end-of-life' concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes, thus operating at the micro level (products, companies, consumers), meso level (eco-industrial parks) and macro level (city, region, nation and beyond), with the aim to accomplish sustainable development, which implies creating environmental quality, economic prosperity and social equity, to the benefit of current and future generations*" (Kirchherr et al., 2017: pp. 224–225). Additionally, they underscored the necessity of renouncing subverted definitions of the circular economy that are mostly framed as a path to economic prosperity and are pushing the social and environmental goals into the background while not recognizing 'Reduce' as a top priority to surpass only incremental improvements and to bring about effective and transformative change. Indeed, only three of the 114 definitions that were analyzed entail all elements of the final definition. Consequently, the imperative of reduction clashes with the business models of the real economy that are built on the pursuit of growth and profit, within the framework of the capitalist market economy, thus hampering the 'strong' sufficiency practices that would be in line with the comprehensive definition of a circular economy that Kirchherr et al. (2017) bring forward. This dilemma is unscored by a study in a sample of 150 companies that proactively communicate their commitment to sustainability and sufficiency but refrain from actually encouraging the refusal to consume (Bocken et al., 2022).

Even if acknowledging the concept of a circular economy as a useful contribution towards socioeconomic system change, measuring the effective reduction of environmental and social damage that it promotes must be tackled, particularly when excessive resource use is not adequately priced and does not include

additional future costs of current resource extraction (Stephan, 2022). Considering that the main strategies for implementing a circular economy include the preservation of the product itself and its function, retrieval of its components, and the recovery of embodied materials and energy, a framework of indicators to embrace these dimensions might consider operating under the concept of *Life Cycle Thinking* to analyze potential (present and future) impacts and the overall burden or benefit for the environment in comparison to linear processes (Moraga et al., 2019). However, reports on interventions at different levels (micro, meso, and macro) do generally not consider the 'use phase' of the life cycle and information on systemic interactions between interventions on different levels is scarce which is particularly unfortunate as the results of interventions on the product level can foster large and unintended rebound effects on the societal or macro level (Makov and Vivanco, 2018).

Limits to a sustainable circular economy

The concept of planetary boundaries aims to define precautionary safeguards for the functioning of the Earth system that should not be surpassed without setting off the risk of abrupt and non-linear environmental shifts that endanger and threaten the safe operating space for humanity (Rockström et al., 2009). Currently, possibly six out of nine planetary boundaries have been breached, including biosphere integrity and climate change (Richardson et al., 2023), which is consistent with the warnings on the rapid deterioration of biodiversity and ecosystem function by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES, 2019) and the 2023 Synthesis Report on Climate Change by the Intergovernmental Panel on Climate Change (IPCC, 2023) that alerts on the effects of human-caused climate change on weather and climate extremes which will continue to intensify.

While socioeconomic and (unfavorable) Earth Systems trends have been accelerating since the industrial revolution, mainly due to the activity of OECD countries and, more recently, due to the emerging economies of the so-called BRICS countries, including Brazil, Russia, India, China and South Africa (Steffen et al., 2015), the General Assembly of the United Nations approved the 2030 Agenda for Sustainable Development (United Nations, 2015), comprising 17 Sustainable Development Goals (SDGs) and 169 targets. Also, the "New Circular Economy Action Plan for a cleaner and more competitive Europe", that was adopted by the European Commission to accelerate the transformations required by the European Green Deal (European Commission, 2020) refers explicitly to the Agenda for Sustainable Development. Yet, in both documents, the notion of sustainability remains rather vague and undefined, being "sustainable" mostly used as an axiomatic justification for policy proposals and goals otherwise deemed desirable such as, for instance, poverty eradication, food security, or economic growth.

Also, seemingly unambiguous definitions of sustainable systems as something that survives or persists (Costanza and Patten, 1995) do not give real meaning to the concept as long as they leave out other dimensions of sustainability such as time, space, or scope. Following Salas-Zapata and Ortiz-Muñoz (2019), the purposes and meanings that can be ascribed to sustainability include (1) a set of social-ecological criteria that guide human action, (2) a vision of humankind that is realized through the convergence of the social and ecological objectives of a particular reference system, (3) an object, thing or phenomenon that happens in certain social-ecological systems, or (4) an approach that entails the incorporation of social and ecological variables into the study of an activity, process or human product (Salas-Zapata and Ortiz-Muñoz, 2019: p. 159). The scope of sustainability might therefore be delimited at the level of values (1) and at the macro (2), meso (3), and micro (4) levels. But additionally, the time horizon can be either short (election cycle), medium (lifetime of current generations), or long-term (future generations), while the spatial scale is local, regional, or global. Thus, only using a definition of 'strong' sustainability (Spash, 2017) that encompasses a comprehensive scope of social-ecological values and systems on a long-term and global scale shall be consistent with the need for guaranteeing a safe operating space for humanity that is faced with challenges such as climate (in)stability, biodiversity loss, or the endangered balance of the Earth system.

Critics of the concept of sustainable development point out that even apparent progress toward its goals generally conceals ongoing environmental devastation (Bendell, 2022; Zeng et al., 2020). Furthermore, the aim of ensuring sustainable consumption and production patterns (SDG 12) seems impossible to attain without effectively reducing production and consumption instead of relying on increased efficiency (which has well-known rebound effects), while the pursuit of economic growth (SDG 8) actually hinders the accomplishment of SDG 12 (Bengtsson et al., 2018). Analyzing the impact of economic growth (SDG 8) on resource consumption Hickel (2019) emphasized that (any) GDP growth would require the decoupling of resource use at a far superior rate than has been achieved historically to effectively reduce the global material footprint (Parrique et al., 2019; Tilsted et al., 2021; Ward et al., 2016). Following a similar line of argument in her critique of SDG 8 that is based on the unsustainability of economic growth, Chertkovskaya (2023) proposes a reframing of the sustainable development agenda into a well-being agenda where human well-being and the need to reduce resource throughput could inform the envisioned socio-ecological transformation.

Besides the antagonism between SDG 8 and 12, in complex dynamic systems like the Sustainable Development Agenda where policies towards a specific goal act on the capacity to accomplish others, it may be expected that these effects are detrimental and create undesirable tradeoffs (Kroll et al., 2019), or even induce unwanted feedback loops, in particular when those goals that would reduce human impact on the Earth system are not prioritized within the framework (Skene, 2021). Supporting this observation, a system-based analysis of local and national policies in Brazil that were informed by the concept of sustainable development concluded that the results were at least inconsistent, both on the economic and the ecological level, while only social goals were (partially) achieved (Donaires et al., 2019).

A reality check on the circularity of the global economy shows that currently only 8.6% can be considered circular, down from 9.1% just two years before, while global material consumption exceeded for the first time 100 Gt of raw materials in 2019, up from 28.6 Gt in 1972 when the Club of Rome's report on the *Limits to Growth* was first published (Circle Economy, 2022). Hence, overall material consumption roughly quadrupled while the world population doubled during the same period (Worldometers.info, 2022) and thus decoupled from population growth, a trend that has been observed for more than a hundred years (Marín-Beltrán et al., 2022). Furthermore, the circular economy does not necessarily lead to a reduction in the use of critical primary raw materials because a shift to different raw materials elsewhere in the life cycle can be observed (Schaubroeck, 2020). In this context, the World Bank Group recognizes that by 2050 the transition to purportedly renewable energy production will require over 3 billion tons of minerals and metals, notably graphite, lithium, and cobalt, corresponding to an increase of up to 500%, to stay within the climate goals of the Paris Agreement, while in regard to suitable minerals like copper and aluminum even doubling the rate of recycling would not meet demand (Hund et al., 2020).

Ageing material stocks accumulated in buildings, infrastructure, and machinery, which have increased 23-fold since the beginning of the 20th century and continue to grow, represent another challenge for the circular economy concept and require continuous energy and material flows for maintenance, dismantling, and (re)construction with a current recycling rate of just 12%, and an anticipated need for disposal of 35% over the period from 2010 to 2030 due to the end of their service lifetimes (Krausmann et al., 2017). Against this backdrop, only a substantially lower level of material stocks would allow achieving a global reduction in greenhouse gas emissions to keep global warming at bay (Krausmann et al., 2020). Thus, circularity must be combined with the concept of longevity to overcome inherent limitations and address material turnover, in an effort to increase eco-efficient resource use (Figge et al., 2018), while rebound effects due to efficiency gains need to be addressed comprehensively (Zink and Geyer, 2017). Moreover, the attempt to avoid landfill within the European Union and to comply with the goal of a circular economy often displaces the treatment of waste towards the global South, feeding into international recycling networks that burden people and environments with cleaning up a problem that they did not cause (Gregson et al., 2015).

Overall, critical reviews of the circular economy point out the flaws of definition and the uncertain overall results, but also the neglect of established knowledge and issues of feasibility, including the limitations due to unaccounted secondary energy and material input due to inefficient limited repurposing or recycling potential (Corvellec et al., 2022; Cullen, 2017). But, additionally, the underlying "ideological agenda" that includes the emphasis on entrepreneurship, business models, and the infinite possibility of technical solutions also derives its strength from the seductive appeal of the circle as the archetype of perfection and completeness, thus turning the metaphor mythical and irresistible (Corvellec et al., 2022).

The unsustainable charm of pro-environmental behavior

The umbrella concept of the circular economy relates closely to the concept of lifestyle in high-income countries of the global North. As laid out by Mikael Jensen (2007), the concept of lifestyle can be defined on four levels, from global to individual, and entails the notion of consumer identity which, besides the manifestations of national, cultural, and subcultural identities, expresses identity on an individual level through the process and type of material consumption. Products perceived as environmentally friendly and fairly traded embody a message of ethical concern and humanitarian consciousness and consumers associate them with a positive moral value that allows to dress up consumption as pro-environmental behavior. Hence, environmentally concerned people tend to achieve self-realization through "green" consumption patterns but don't forego necessarily consumption and resource use itself, focusing instead on measures that are promoted within the concept of a circular economy, like (zero-)waste and recycling, to maintain consistent personal narratives (Connolly and Prothero, 2003) or to enhance their positional value in the peer community (Kesenheimer and Greitemeyer, 2021). As emphasized by Lorek and Fuchs (2019), this type of 'weak' sustainable consumption represents foremostly purchasable efficiency gains that are available to affluent consumers and occur without effective environmental gains, an observation that is also supported by Moser and Kleinhückelkotten (2018). On the contrary, 'strong' sustainable consumption requires embracing sufficiency and the reduction of overall consumption in high-consuming classes which could grant a dignified life for all and replace the growth paradigm (Sandberg, 2021; Sandberg et al., 2019).

Indeed, higher household income is closely associated with a greater ecological footprint (Adua, 2022; Alfredsson et al., 2018; Feng et al., 2021; Hardadi et al., 2021) and individual environmental concerns and pro-environmental behavior in the private sphere do not necessarily reduce household carbon footprint (Csutora, 2012; Huddart Kennedy et al., 2015). Thus, the example of air travel, which represents a major share of individual greenhouse gas emissions, particularly in high-income urban populations (Czepkiewicz et al., 2019; Ivanova et al., 2020) and is rarely relinquished, demonstrates that even people with internalized knowledge about climate change show a large gap between attitude and practice (Jacobson et al., 2020). This finding is supported by the analysis of representative datasets of the UK population which also showed no association between pro-environmental values and concerns and the reduction of non-work-related flying behavior (Alcock et al., 2017).

The apparent inconsistencies between pro-environmentalism, "green" lifestyle, and environmentally harmful habits like travel patterns with high climate impact seem difficult to explain at first glance. However, alongside denial mechanisms that are similar to those that erect psychological barriers to shifting from material comfort to a low-energy behavior (Stoll-Kleemann et al., 2001), moral disengagement triggered by aggressive advertising of long-distance travel contributes to the blanketing out of its climate effects (Stubenvoll and Neureiter, 2021). Additionally, the effect of moral licensing may further enable the denial of existing contradictions between material and energy consumption, associated greenhouse gas emissions, and the narrative of a sustainable circular economy. In moral psychology, ethical behavior is closely linked to the self-perceived value of moral acts that interfere with self-interest. But while past transgressions increase the resolve to engage in ethical behavior, the boost to the moral self after acting ethically can provoke subsequent licensing of egoistic and unethical attitudes, particularly when there is a conflict between self-interest and an abstract value or goal, or self-construal is based on social roles and relationships (Blanken et al., 2015; Mullen and Monin, 2016; Xiong et al., 2023).

Under the assumption that purchasing environmentally friendly products might prompt subsequent unethical behavior, Mazar and Zhong (2010) studied the effect of moral licensing in an experimental study on Canadian students that showed a positive association between the prospect of green consumption and high moral and social values. However, while the mere exposure to environmental-friendly products had a favorable effect on altruistic behavior, the actual purchase of these products led to a decrease in altruistic behavior and even to clearly unethical conduct. In a similar study on the potential of behavior change initiatives and policies to increase overall pro-environmental behavior (positive spillover), Clot et al. (2022) studied the effect of "green licensing" in a group of 85 undergraduates at a UK university and concluded that licensing actually provoked a negative spillover and worse pro-environmental behavior in other domains. Additionally, engaging in moral licensing can contribute significantly to the rebound effect that is observed after efficiency gains through technological improvements, in particular regarding heating and mobility, thus expanding on a mere economic explanation of rebound (Dorner, 2019; Dütschke et al., 2018).

Complementing this argument within a larger moral self-regulation framework, Shalvi et al. (2015) emphasize that self-serving justifications act in protection of the moral self, either in advance of intentional unethical behavior, resorting to mechanisms of ambiguity, self-serving altruism, and moral licensing, or afterward, using physical or symbolic cleansing, partial confessing, and distancing with pointing to others' moral failures. Thus, in analogy, the peril of the circular economy narrative lies in its

apparent logical serenity and opportune resolution of the psychological intricacies that characterize the conflict between 'green lifestyles', enacted pro-environmentalism, and engrained consumption patterns, while its mainstream meanderings refrain from substantially transforming the growth economy.

Clues for transformative change

The concept of zero-waste, recycling, and a circular economy does not only operate on an individual level to justify unsustainable consumption patterns but can also be understood as an attempt to render the challenging of industrial capitalism impossible, removing it from the political sphere towards a depoliticized question of consumer behavior (Valenzuela and Böhm, 2017). But even when consumers turn to recycling fetishism, in a symbolic effort of redemption that suppresses the acknowledgment of wasteful behavior and intends to obtain moral permission for future consumption, the cleaves and cracks of the current global socioeconomic system become visible. Hothouse Earth pathways loom on the horizon (Steffen et al., 2018) and disruptive behaviors of the Earth system are not science fiction anymore but a real prospect (Bernardini et al., 2022). The call for environmental justice and decolonization can no longer be ignored (Sultana, 2023) and resounds with proposals for a degrowth future in the global North (Singh, 2019; Sultana, 2023). Thus, "ideas such as those of subsistence-living, the balance between all living beings and reciprocity, self-sufficiency, and self-reliance open the possibility for debates in which both sets of movements can contribute", thus co-creating convivial technologies and alternative economic systems that refuse neoliberal growth narratives (Rodríguez-Labajos et al., 2019: p. 182). Moreover, the current social and ecological crises require imagining "other ways of being, and transformative change to our economic life", where "the social body, with a shared commitment to life in common, is a common goal that unites diverse struggles, including environmental justice and degrowth movements. The success of these diverse struggles in fostering collective subjectivity and postcapitalist alternatives will depend on the ability of these diverse movements to come together, stand in solidarity, learn from each other, and tell alternate stories about how we are to live the Anthropocene" (Singh 2019: p. 141).

Natalie Ralph's proposal of conceptual merging of circular economy, degrowth and conviviality design approaches might represent a first step in the direction of circular futures while reappropriating the idea of a circular economy for a framework that embraces local sourcing of raw materials, the possibility of local manufacturing, and the inclusion of users' creativity in the design process, thus creating products that fulfill an effective need and not an artificially induced desire, are widely accessible, contribute to future sharing and learning, and can be modified or improved without restriction during an extended life cycle and repaired by an average person (Ralph, 2021). This proposal, however, requires engaging in a participated policy process which is critical to achieve indispensable popular support (Kongshøj, 2023) and will be characterized by the need to address complex problems within the uncertainties of post-normal science where decision stakes are high (Funtowicz and Ravetz, 1994). Hence, a circular economy discourse that aims to reach beyond variations of the R's of waste management and resource use will necessarily have to embrace systemic socio-ecological transformation and a "plurality of alternatives" to envision participated circular futures (Calisto Friant et al., 2020). Alongside the acknowledgment of planetary boundaries, the formulation of societal boundaries is mandatory to enable a fair and conscious decision process that creates the conditions for a good life for all within a framework of collective self-limitation which overcomes the imperial mode of living at the expense of others (Brand et al., 2021).

The transformation of social structures that allows us to envision a future that entails elements of the circular economy without succumbing to its vicissitudes will possibly require the shift from market relations to human relations, within a framework of "intentional sharing and togetherness" (Jarvis 2019: p. 270). Renouncing explicitly the idea of a consumption-orientated sharing economy, Jarvis puts forward a concept of "real places and co-present realities" that might occur in collective endeavors like co-housing or food cooperatives which, in turn, shape relational human values. This framework entails individual agency, collective intentionality and 'we-intentions', participatory democratic procedures, and the defense of ecosystems and ideals of social justice within practices inspired by the degrowth mindset, understood as a "radical niche innovation" to counter the dynamics of growth capitalism and to create diverse—pluriversal—pathways towards alternative practices and systemic change (Kothari et al., 2019; Vandeventer et al., 2019).

Concluding remarks

The amazing diversity of circular economy definitions seems to allow picking and choosing those that are most suited to one's preferences and particular circumstances, without changing the dynamics of the industrial growth economy or demanding radical individual and systemic transformation. Thus, the utopia of circularity apparently sanctions the maintenance of privileged habits of conspicuous consumption, within a framework of green lifestyles and pro-environmental behaviors, to end up reinforcing the *status quo* of unsustainable exploitation of the Earth's resources while only a small—and diminishing—fraction of materials is reused or recycled, and global consumption continues unabated. Psychological mechanisms like moral licensing can hinder transformative behavioral change even in groups that exhibit high moral standards and acknowledge the predicament of the destruction of the biosphere, particularly when its members enjoy the economic privileges that entitle them to an environmentally destructive lifestyle. In contrast, 'strong' sustainability and an all-embracing circular economy require prioritizing 'Reduce' without losing sight of social and environmental justice. Thus, without a paradigm shift in overall societal goals from economic growth towards sustainable and regenerative practices, the current conflict between self-interest, interwoven with dominating societal norms, and consistent pro-environmental behavior remains irresoluble, except in fringe groups that operate outside of the mainstream society and either are driven by strong moral values or bound to vernacular lifestyles that are directly threatened by the industrial growth economy.

Data availability

Data sharing is not applicable to this research as no data was generated or analyzed.

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