



## CIRCULATING OBJECTS, CHANGING SCALES: Circular Cambodian Worlds and Economies

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As mountains of waste give shape to a “new geological stratum” (O’Neill 2019, 1) across the planet, the ambition to create a circular economy that “would see nothing discarded and everything reused” (O’Neill 2019, 2) has grown into a complex governance agenda (Volk 2004). Since the 1990s, China has sought to close waste loops in alignment with a version of economic development in a “harmonious society.” Germany introduced circular economy into environmental and industrial policies focusing on sustainable growth, and the European Commission is committed to a circular agenda (Winans, Kendall, and Deng 2017). In 2018, the Cambodian National Council for Sustainable Development, too, declared an ambition to turn “the national economy into a sustainable enterprise based on a closed loop to achieve the highest degree of efficiency and productivity possible and protect the Kingdom’s natural heritage.”<sup>1</sup>

An obvious test case for studies of environmentality—the study of new modes of environmentally oriented governance (Gabrys 2014) and subject-forming processes (Agrawal 2005)—these developments also resonate with questions raised by anthropologists and fellow travelers about what it might mean to “think like a climate” (Knox 2020) or via “urban metabolism” (Mohácsí 2021),

do “planetary social thought” (Szerszynski and Clark 2020), “learn to compose with Gaia” (Stengers 2018), or get “down to earth” (Latour 2018). From a slightly different angle, circular practices and projects raise questions about relations between circulating objects and modes of valuation for STS (science and technology studies), market anthropology, and economic sociology. The following travelogue through some Cambodian “mindscapes and landscapes” (Haraway 2004, 63) brings these agendas into communication as a form of empirical, applied metaphysics.<sup>2</sup> Focusing on circulating objects and the divergent worlds they shape, it takes us to sites where “worths” are negotiated and tested and examines the formatting of circular agendas more or less attuned to diversity (Eitel 2022; see also Morita and Tsuda 2022). Rather than a single, homogeneous circular economy, the analysis elicits a patchwork of partly overlapping, uncommon circular worlds (Blaser and de la Cadena 2017; Jensen 2017).

### FROM THE CIRCULAR ECONOMY TO CIRCULAR WORLDS

The origins of the circular economy are mixed but share the observation that economic and environmental issues are entangled. In the mid-seventies, for example, the architect Walter Stahel and the social economist Geneviève Reday-Mulvey (1976) associated regional European job creation, resource efficiency, and waste prevention in analyzing possible strategies for a loop economy (Geissdoerfer et al. 2017). A decade on, the economists David W. Pearce and R. Kerry Turner (1989) retrieved Kenneth Boulding’s (1966) view of the earth as a closed system (“space-ship earth”) to replace linear economic understandings with an alternative premised on keeping natural resources in equilibrium. Meanwhile, industrial ecology traced material and energy flows and introduced the notion of urban metabolism (Wolman 1965), a term that would later be put to different use as part of critical urban geography and anthropology (Swyngedouw 2006; compare Zhang 2020) and social-ecological systems research (Grimm et al. 2008; compare Newell and Cousins 2014). Subsequently the Ellen MacArthur Foundation (2013, 23) repackaged these ideas alongside others, like cradle-to-cradle and the blue economy, with a view to close the loop in an “industrial economy that is restorative by intention and design.” Similar aspirations inform the “doughnut economics” popularized by Kate Raworth (2017).

During the same period, new ideas about market exchange, culture, and values percolated through the social sciences. Michael Thompson’s *Rubbish Theory* (1979) examined the changing status of objects as they move between being transient, durable, or mere garbage.<sup>3</sup> Rather than a material property, rubbish appeared

as a category for things that had been assigned negative value. The content would vary with sociocultural classification systems, he surmised, but the category itself was inescapable and, in that sense, universal. Despite the mixed feelings one might harbor about that particular claim, Thompson offered quite an elegant analysis. One drawback, however, was that the abstract level at which the theory was pitched removed focus from the actually circulating and value-changing objects that would instantiate it. The specifics, so to speak, tended to drown in the universal.

Some years later, the edition *The Social Life of Things* promoted more detailed inquiries into the “specific cultural and historical milieus” through which objects circulate (Appadurai 1986, 4). Studies suggested that no such thing as “the market” existed, but rather culturally specific regimes of value.<sup>4</sup> Igor Kopytoff’s (1986) contribution developed an analytic of “biographies of things” in analogy with people. Such biographies would include descriptions of how a thing is made. The culturally ideal trajectory of a thing might be compared with its actual “career.” Changes to “status” over the lifespan of a thing might be examined. And, similar to how one might depict the life stages of a person, a thing would be described as living through different states: from being made or found, to being sold, fondly used until people lose interest or it starts to fall apart, at which point it may end up in cabinets or basements, until forgotten, found again, passed on, or thrown away.

These innovative ideas still had some limitations and blind spots. One had to do with the status of the objects, which actor-network theory had begun conceptualizing in terms of material agency. As Koray Çalışkan and Michel Callon (2009, 390) perceptively noted, the argument that circulating objects are inscribed with values that *illuminate* social contexts, *but no more than that*, relied on a fundamentally asymmetrical understanding of humans and nonhumans. In contrast with people, who actively change things, make them circulate, and endow them with significance, things only hold up a mirror that reflects cultural values back to people. A more symmetrical approach would give the objects other forms of liveliness, or agency, including the capacity to actively reconfigure the people and assemblages they become part of.<sup>5</sup> Rather than studying the market or the economy as a kind of container inside which things change hands between people, one would then examine how what we refer to as “the market” or “the economy” is generated, stabilized, or destabilized, by changing patterns of human and nonhuman relations (see also Callon 1998).

Çalışkan and Callon had less to say about another shortcoming of *The Social Life of Things*, perhaps because it also touches their own approach. In both cases,

the emphasis is on the diverse lives of commodified things. Çalışkan and Callon turn those things into material agents playing crucial roles in reshaping assemblages. But the focus remains firmly on processes of economization. While there is nothing wrong with that focus, it is firmly situated on only one side of (Western) value discourses, which have traditionally split into two (Smith 1991, 30–36). For the side that holds the interest of these authors, value pertains to instrumental, material, and economic matters, including those of trade and industry, production, consumption, and so forth. Yet from another side, value evokes various features of what is usually seen as distinctly non-economic realms, such as those of religion, ethics, art, or the finer feelings.

The variability and complex relations between such very different values, or worths,<sup>6</sup> lie at the center of Luc Boltanski and Laurent Thévenot's (2006) *On Justification*, a book that explores the heterogeneous "pragmatics of justification" characteristic of different worlds.<sup>7</sup> The authors consider six such worlds—the inspired world, the domestic world, the world of fame, the civic world, the market world, and the industrial world<sup>8</sup>—in terms of their organization around distinctive worths. The civic world, for example, valorizes public representation and participation and aims to protect social collectives against disunity and violent breakdown, while the market world revolves around competition, interests, and desires (Boltanski and Thévenot 2006, 185). The market, however, does not equal the entire "sphere of economic relations" (Boltanski and Thévenot 2006, 193), which also encompasses the quite different "world of industry," where efficiency, performance, and utility prove central. This is the world in which "technological objects and scientific methods have their place" (Boltanski and Thévenot 2006, 203). This focus on variable justifications has a pluralizing effect. It becomes possible to study circular economies beyond questions of economic markets and commodification. We find ourselves moving between worlds—the market world being only one—inhabited by actors who ascribe different meanings, values, potentials, and risks to circularity and enact it very differently.

### **CIRCULATING OBJECTS, CHANGING SCALES: An Applied Metaphysics**

The "biographies of objects" approach advanced by the historian of science Lorraine Daston (2000) makes it possible to connect questions about worlds and their worths with circulating objects, material agency, and scale-making. Daston (2000, 1) characterized such biographies, which would revolve around the "dynamic world of what emerges and disappears," as a form of "applied metaphysics."

The exceedingly heterogeneous objects<sup>9</sup> that appear in the pages of her edited volume include “dreams, atoms, monsters, culture, mortality, centers of gravity, value, cytoplasmic particles, the self, tuberculosis” (Daston 2000, 1). Their varied lives provide an image of reality itself as “a matter of degree,” in which existence makes for a relative property, something to be gained or lost depending on “how densely [objects] are woven into . . . thought and practice (Daston 2000, 1; see also Latour 2000, 251).

As exercises in applied metaphysics, such object biographies go considerably beyond the material flows that appear in recent discussions of urban metabolism, since their itineraries involve changing ontological relations: The circulating objects are active participants that modify the composition of worlds and influence the negotiation of worths.<sup>10</sup> Accordingly, they prove highly interesting for explorations of varied and contested green agendas (Blok 2013). This means that, material agency, as used here, has little to do with the endeavor to excavate the shimmering, vibrant (or withdrawn) core of objects. Instead, such agency is brought to life by the tracing of movements and circulations, reciprocal relations, and redistributions of agency in and across worlds.

Pursuing applied metaphysics or practical ontology (Jensen 2021b) by empirical means has the advantage of opening a way of thinking about scale that avoids the false certainties and determinisms of conventional alternatives.<sup>11</sup> For it is, again, not the case that the objects circulate within a container world that has a given scale. Instead, objects make or break relations as they circulate, which means that they strengthen some (or parts of some) worlds while weakening others. They are, in effect, adding to or subtracting reality from worlds and worths, helping them grow or shrink, *scaling them up or down*. From this angle, what is usually called large-scale phenomena are patterns of circulating objects densely interwoven with many distributed practices and therefore able to generate widespread and diverse effects. But such dense relations can loosen or fall apart, in which case the reality of both objects and practices begin to diminish. They are then losing scale, potentially until they completely cease to matter. Since everybody is trying to scale particular worlds and worths, we are invariably dealing with “awkward situations” and the “ambiguity of composites” (Boltanski and Thévenot 2006, 226). *Whether* the circular economy, or other greener worlds, are happening, remains quite uncertain. But *whatever* happens, in terms of empirical metaphysics, it will be an effect of circulating objects traversing and modifying worlds, of scaling them up or down.

Minimally, it seems that the emergence of circular worlds will depend on emerging coalitions of what Donna Haraway (2004, 77) once called “shifted subjects” committed to significant transformations. At issue is not a heroic once-and-for-all decision to move to a permanently altered subjectivity, but rather gradual processes of detaching from linear worlds and worths and attaching to other, greener ones (see also Jensen 2019). Accordingly, it becomes important to describe this traffic across worlds and characterize what is coming together and breaking apart. It also becomes a matter of conceptual and practical significance to learn to discriminate between different forms of more or less circular, or green, subjects, objects, and processes.<sup>12</sup> With this in mind, I proceed to examine the biographies of some innocuous objects as they weave their way in and out of practices, traverse different worlds, and become entwined with variable worlds and worths.

### THE STRAW AND THE COCONUT

Thavy and her sister have been searching for fabrics at the busy Toul Tom-poung market. Now, squinting in the sun outside, they buy a fresh coconut. The vendor chops off the top and inserts a plastic straw. After sipping the cool milk at a wobbly table, the women hop on their moto and continue their chores. The empty coconut, straw sticking out, remains behind. Half an hour later, it is unceremoniously dumped on top of a pile of roadside trash. In the afternoon, Chanthet walks by, pulling a cart. Sifting through the garbage, she picks up the coconut, along with half-eaten watermelon, mango, and vegetable peel. Twelve kilometers, or an hour’s traffic congestion away, back in Som Rong village in the northern Sen Sok district, the straw is removed from the coconut, which is placed into a shredding machine. Along with other organic materials, it enters one of a dozen containers. Eventually, the compost will return to the markets.

Chanthet is one of Phnom Penh’s several thousand informal waste-pickers. Informality, in this context, entails neither disorganization nor randomness. Kathrin Eitel (2021) has used the term *infracycles* to capture durable temporal and spatial patterns emerging as waste-pickers make their daily rounds and sell goods at small depots or large dumping sites, and as some of these goods cross the borders of neighboring countries for recycling. But from the moment this coconut husk is swept up along Chanthet’s trajectory, something slightly unusual obtains about its biography. That is because Chanthet works with a small NGO called Community Sanitation and Recycling Organization (CSARO).

The organization was established in 1997 to support the living conditions of urban waste-pickers with funding from the United Nations (UN) and other

development agencies. To this day, the webpage describes several goals: empowering urban communities and waste-pickers (“who make their living by sorting through rubbish on the street and from piles of garbage”) to create better family economic conditions for a sustainable future, working together to transform slum areas into clean, safe, and healthy places, and encouraging poor urban people to improve their capacities.<sup>13</sup> In the early days, the organization created a participatory urban community organizing and infrastructure program, which installed new drainage and sewer pipes in a few areas without coverage. However, as sponsors lost interest and money streams began to run dry, it had to scale down. Currently, CSARO runs a small plant that converts organic materials into compost. It has conducted a community forum on how to “break free from plastic,” and some now turn straws (like the one picked up by Chanthet) into decorations.

To get a sense of why she and others got involved, let us look at a few virtual self-presentations. Vong Saven, aged forty-five, explains that she and her husband, a moto taxi driver, have three kids but very little money.<sup>14</sup> The handicrafts she makes sell for around US\$35 per month, around the same as she used to earn as a dressmaker. But that job proved physically demanding and financially unstable. Saven tells that her self-esteem has now increased, since she is more respected by her husband and neighbors, and she mentions her dream of “expanding the business.” Thirty-five-year-old Tim Channy, who was evicted from the Bouding slum area in 2000, shares a similar story.<sup>15</sup> She can earn US\$60 from work at the composting plant, and this has improved her confidence, because it allows her to support her family and send her children to school. She just barely gets by and is without TV or radio, yet the ability to keep her family afloat provides her with respect in the community.

A coconut and a straw. Neither exactly makes for a high-profile object. As low-value commodities in a linear economy, they appear similar in some respects. The coconut grows before it is harvested, and is then transported to the market, where it is piled up, sold for a few thousand riel, cut open, drunk, and discarded. The plastic straw is also oriented to easy consumption and disposal, though its biography is more complex and environmentally harmful. But that is not the whole story.

With the arrival of Chanthet, the objects begin to travel different circuits. Soon, they will traverse worlds that involve several value chains beyond those of economization. It is not, of course, that commodification or the market simply vanishes. After all, CSARO states the explicit goal of improving economic conditions for the poor and creating possibilities for better living. But those dreams are

now complemented with different justifications, which testify to the significance of other worlds and worths. One unit is domestic, with an emphasis on families; but there is also a civic emphasis on building stronger communities. The material agency of the straw and the coconut is elicited in how they redistribute agency, shift subjects, and participate in changing the scales of lives and arrangements in those worlds. Saven and others get an income, but now, at the same time, they are making Cambodia cleaner or greener and therefore feeling pride as members of their communities and ensuring the safety of their families.

These shifts are interrelated with tenuous attempts at making greener worlds and scaling up circularity that take place elsewhere. To make sense of those partial relations, we must take leave of the straw and the coconut.

### **TO CHANGE THE WORLD BY CROCHETING PLASTIC**

Darith receives his ice coffee in a plastic cup with a plastic straw in a small plastic bag. After sipping the drink from the back of his friend's motorbike, he flings the bag on top of a small garbage heap by the side of the road. As she finishes grocery shopping, Nich carries plastic bags stuffed with noodles, eggs, fruit, formula, and soap. After placing the goods in her small apartment, she goes outside and puts the bags on top of the same pile. If the afternoon rain is heavy, much of this garbage will flow down the street, some of it clogging the drains, and other bits sailing into the nearby canal. But on this day, Srey Mom arrives before the rain. Pulling her cart along the street, she pauses briefly, picks up the plastic bags, and moves on. They end up at the Funky Junk Recycling central.

A small-scale business, Funky Junk Recycling was founded in 2005 by a Western couple who had lived in Cambodia for several years. While organizing travel tours, they noticed plastic choking streets, fields, and streams, and decided to do something about it. They hired waste-pickers to collect plastic bags and others to turn them into purses, baskets, meditation cushions, and laptop covers back at the small central.

Funky Junk resembles CSARO in some respects. Both train and employ poor urban Cambodians to upcycle waste. Both connect with local schools as part of educational outreach. And not unlike CSARO's self-presentations, a Funky Junk promotional video features thirty-four-year-old Earn Mou who explains that plastic crocheting provides him with an appealing livelihood alternative to pepper farming or heavy-duty construction work.<sup>16</sup>

There are also significant differences. In contrast with CSARO's information, mainly in Khmer, Funky Junk's video is in English. It is found on the crowdsourcing



site Indiegogo.com as part of a campaign run a few years ago in search of “backers” who would help “kickstart” the goal to upcycle 1 million plastic bags. After panoramic shots show the inescapable contrast between beautiful landscapes and dirty plastic heaps, the video asks, “What if you could change the world simply by collecting plastic bags?” A similar sense of scalar dissonance—to change a planetary problem “simply” by doing your tiny bit—reappears in the campaign mission statement to “kickstart the global growth of an established social enterprise making funky home accessories.”

The previous section sketched how the biographies of the coconut and straws were woven into various worlds and worths: domestic (familial and communal), civic (in support of the urban poor), market (selling handicrafts), and circular (composted and recycled). The plastic bags collected by Darith and upcycled by Mou also become variably entangled, but not in the same way. While civic worths inform skill training and educational campaigns, and everything is wrapped in a green concern with plastic pollution—change the world by cleaning the streets—the trajectories diverge once the bags are upcycled. Because the destinations of Channy and Saven’s compost and handicrafts and Mou’s crocheted meditation cushions differ. While the former returns to the cheap, local Toul Tompoung market, the latter make their way to a dispersed, partly virtual, market comprised of small boutique shops and hotels: Villa Langka, iChing Décor, and Elsewhere in Phnom Penh, MoreThanHip in the Netherlands, Upcycle Studio in Australia.<sup>17</sup>

The names tell part of the story. The dry-sounding Community Sanitation and Recycling Organization communicates with the world of socially responsible development aid. It tries to scale local domestic, communal, and environmental relations differently, but struggles to keep afloat because of the shifting interests of supporting donors. In contrast, Funky Junk names and joins a dispersed, global phenomenon. Across the world, there are numerous funky junks that try to scale-up trendy, innovative, environmental fashion consumption. However, as the kick-start campaign indicates, that aspiration is fraught with difficulties. The campaign goal had been set at 40,000GBP, but in the end, twenty backers had contributed only 686. Perhaps it isn’t too jaded to read into the website encouragement—to please “get in touch” if you want to become an international retailer—just a tinge of desperation.

Thus, circulating objects become inscribed with different worths. At the same time, they redistribute agency among the actors that engage with them and join diverse efforts to scale their worlds differently. Tensions emerge because those different scaling projects occur simultaneously and are often in conflict. But it

is not only objects that circulate. In some situations, representatives of different worlds come together to figure out how to change the circulations of the objects and reshape circular worlds. These are circular test-sites, where the worths of different worlds are compared, evaluated, and negotiated.

### A TEST-SITE

Before the Cambodian government and international donors began campaigning on behalf of the “3Rs” of waste reduction, reuse, and recycling, several businesses and practices were *de facto* involved in circular practices. At one end, Chip Mong Insee had begun to use waste as energy for cement production.<sup>18</sup> In the special economic zone on the outskirts of Phnom Penh, clothes manufacturers incinerate waste to make steam for production. In Battambang, the Global Green Growth Institute (GGGI) supports solid waste management and plastic recycling as part its global business accelerating program, Greenpreneurs.<sup>19</sup> Elsewhere, family businesses feed household biodigesters with agricultural residuals. Some farms grow black-soldier-fly larvae on waste (compare [Zhang 2020](#)) and sell them to poultry producers or make briquettes from coconut shells or fuel from rice husks. And while city authorities seek ways to turn municipal waste into electricity, various small-scale operations (CSARO and Funky Junk Recycled, which we have met, but also Naga Earth, Rehash Trash, Battambang Plastic Products, and the Japanese Gomi Recycle 110) trace their own paths. The daily infracycles of informal waste-pickers and other half-forgotten or unnoticed agents—from locals running recycling depots to foreign waste entrepreneurs—testify to yet other circular agendas under difficult conditions ([Eitel 2022](#)).

In February 2020, those entities, large as small, appeared on PowerPoint slides at a learning event hosted by an international development agency. Although the workshop was open to anyone interested and had been broadly advertised, only some of those represented were physically present. It is likely that then rapidly growing COVID-19 concerns played a part. Aside from that, the usual, mundane selection mechanisms—different towns, busy schedules, language difficulties, and strapped funds—conspired to keep smaller, local organizations away. Among the participants were representatives from apparel manufacturing, plastic recycling, GGGI, a Siem Reap-based waste-management initiative, and some NGOs. There were also presenters from a trendy consultancy bureau and a development accelerator lab, along with policy and communication experts.<sup>20</sup>

So, asked to speak about the challenges of a circular economy, what did this group have to say? Quite a few different things.<sup>21</sup> It will hardly come as a surprise

to hear the voice of the market: there is “no strong market for recycling.” Inadequate access to a “portfolio of clients” means that businesses face a problem of “scalability.” As for recycled products, they lack “opportunities for visibility.” This means (regrettably) that waste-to-energy projects (WtE) are simply “not profitable” at this time. But it did not take long for other worlds to appear.

From the side of the market, WtE and large-scale recycled-plastic products appear unprofitable because of high costs and few customers, but that problem might be solved “if a coalition of businesses [were to] say, ‘We are willing to buy plastic under certain conditions.’” Worths begin to blur because those conditions immediately involve the industrial world. From this angle, the major hurdle is the inferior quality of recycled plastic pellets made in Cambodia. In part, this is because there are no production guidelines or certification requirements. But circularity is also impeded by a “bumpy supply chain.” If quality and delivery were up to speed, it would be possible to make money, *in which case* a business coalition might pledge to use them. But as this is very far from the case, there is presently a “huge import into Cambodia of recycled plastic, which is used to produce clothes that go out.” “It is crazy,” observed a company representative, “but there is nothing I can do.”

Worried about efficiency, a voice from the world of industry opines that “operational costs are too high.” Once again, the solution switches register. Since it will be next to impossible to streamline operations sufficiently, successful circular production “would depend on subsidies.” In one smooth motion, we therefore glide into the world of civics, where good governments ought to support businesses who want to make their practices sustainable. “It is in our business DNA to be socially responsible,” someone proclaims, accompanied by vigorously nodding heads. *Alas, if only we could be.*

As we move from markets to civics, from industry and back to markets, heterogeneous explanations and ripostes weave a dense pattern of shifting worths. Now the world of fame makes a sideways entrance because, possibly, what is needed for recycled products to really take off is making them fashionable. This is why GGGI collaborates with Coca-Cola, which has a “very high brand value.” Showcasing bottles made of recycled plastics might create a win-win situation in which Coca-Cola brands recycled plastics while recycling brands the company as a “social enterprise.” A communication specialist agrees it is crucial to get the right message across. Plastic elimination and pollution both face “barriers and awareness gaps,” which can be closed by a “big focus on empathy-based communication.” But

rather than increasing the sale of soft drinks, her endgame is “empowering people” by the provision of knowledge.

The second half featured presentations by the consultants and the accelerator lab. Both had conducted small surveys and interviews with market vendors and customers. The unfortunate finding was that Phnom Penh’s humongous plastic problem was not widely recognized. In fact, vendors had numerous good reasons for using single-use plastics. Those reasons, too, jumbled together various worths from market, industry, civic, and domestic worlds. One: there is no customer demand for recyclables. Two: even if it might be possible to use rice, paper, or grass straws, ensuring adequate supplies would be difficult. Three: those alternatives would be costlier, and price increases are difficult to fob off on buyers who didn’t ask for any changes. Four: customers want straws for hygienic reasons. Five: when it comes to wet markets, dealing in raw meats or fish, there are no real alternatives to Styrofoam. There aren’t enough banana leaves or old papers to go around and, anyway, they still leak. Moreover, even though markets are formally run by management committees, they hold no regular meetings. And while waste-management protocols do exist, it seems that vendors neither know nor care about them.

What kind of leeway did these descriptions create? The consultants suggested that market ambassadors might be recruited to relay up-to-date information to vendors. If the locals had appropriate knowledge, they might be activated by training or competitions to come up with their own alternatives. To alleviate vendor worries about a potential future plastic ban, it would also be important to communicate how the Cambodian government was working to “support their needs.” One might object that the primary issue identified in the survey was not lack of awareness but of good alternatives. But in a sense, these recommendations are not very surprising, since awareness and information are precisely what consultants trade in.

As for the present redescription, it has evoked the workshop as an ambiguous situation, a test-site and collective joust (of sorts) between worlds that define the circular economy variably in relation to their own preoccupations. Representatives of different worlds emphasize different circulating objects as significant for enhancing circular agendas, and they express different ideas about why they matter, what should be done, when, and by whom. But at this moment, no unequivocal conclusions emerged. To learn something about how relations between the worlds are formatted, and to which effect, we must once again look elsewhere.

## FORMATTING CIRCULAR WORLDS

In the fall of 2020, the German Konrad Adenauer Stiftung organized Waste Summit 2020 as a mix of online and onsite events in Phnom Penh,<sup>22</sup> and in the summer of 2021, the Cambodian government launched its Circular Economy Strategy and Action Plan. Meanwhile, informal waste collectors continued to make daily rounds. How do these circular agendas and practices format relations between different worlds and worths?

The national strategy and action plan mapped an open-ended set of problems, challenges, and solutions focused on the twin difficulties of waste management and plastic pollution.<sup>23</sup> Among other things, it dealt with problems pertaining to: *Finance/Markets*: Markets for recyclables and organics are undeveloped; there are limited economic incentives; waste disposal is cheaper than treatment. *Management practices*: Single-use products are mass consumed; waste collection is lacking; waste is unsorted; the institutional roles for support of recycling are unclear; there is an irregular and insufficient supply of feedstock for recycling; dumping often takes place in streets and waterways. *Regulatory*: There are few policies for energy efficiency and recyclable energy; there is no enforcement of waste segregation; permit requirements are complex and expensive; administrative delays are frequent; environmental standards and guidelines are limited. *Information*: Awareness of sustainable consumption is missing, as is knowledge of waste-treatment options and baseline data of all kinds. *Infrastructure and Technology*: There is limited infrastructure for electric vehicles; there are no eco-industrial parks or recycling clusters; also, there are no community recycling points or deposit systems; technologies are generally inefficient or outdated; no large-scale organic waste-treatment infrastructure exists; skilled domestic labor is inadequate; controlled land-fill capacity functions only to a limited degree. And so on.

This way of mapping the circular landscape can be described as additive. Rather than aspiring to the (dreaded) “view from nowhere,” we get something like a view from everywhere: local communities over here have *these* domestic or civic problems with lacking information and garbage collection, but municipalities over there face *these* industrial issues with landfills and tariffs. All these different versions are moreover variably compromised by factors originating in other worlds. Obviously, market and industrial worlds have a strong presence, but so do civic worths, evoked in the dual form of government responsibility to enlighten citizens through knowledge-sharing and to ensure the future environmental health of the public by incentivizing a greener economy. As all issues are listed side by side, without any particular commitments or recommendations, this appears like quite

a relativistic grid. However, since the report forms part of an agenda to scale circularity up to national level, that is likely to change before long. While open-endedness is relatively easy to maintain discursively, and on paper, the enactment of circularity across the landscape will involve tough decisions about priorities.

Questions of how to scale up and gain reality and importance were also at the heart of Waste Summit 2020, which focused on waste conversion and exploitation for “economic development purposes.” It was described as a “platform to enable future partnerships” and emphasized the potentials of large-scale (German) waste solutions for Cambodia. Presentations revolved around the technology transfer of mechanical biological treatment solutions, WtE capabilities, and industrial-scale waste-management plans. Live events included a visit to Chip Mong Insee’s energy-efficient cement kiln, green drinks at a local, sustainable restaurant, and matchmaking sessions between local enterprises and European circular specialists.

As suggested by the focus on municipalities and landfills, corporations, malls, and special economic zones, the Waste Summit invites us to accept and join a rather clearly defined hierarchy. This circular formatting is fully immersed in market and industrial worlds, and the central question is how to make large-scale processing feasible and profitable by ensuring sufficient flows of waste. There is limited focus on issues like creating green shifts and forms of solidarity among waste collectors and their communities, and much interest in aligning the industrial conversion of waste to energy with the image conversion of corporate and national profiles from gray to green. As other worlds and worths are relegated to the shadows, circular diversity more or less evaporates.

## PLASTIC SOLUTIONS

The problem of plastic pollution is yet again configured differently. This problem space is defined by the preponderance of market actors for whom profitability constitutes the central worth and by the material recalcitrance of plastics. Now, plastics are profitable if they can be disposed at no cost; in other words, as long as social and environmental damages are defined as externalities. Meanwhile, plastics have a “miasmatic” (Liboiron 2013) tendency to seep into and become entangled with organism and ecologies from the bottom of the sea to mountain peaks. They are, moreover, durable and difficult to get rid of, which means that clean-up efforts often amount to a reshuffling “in space while they [plastics] endure in time” (Liboiron 2021, 17). As plastic production has exploded over several decades, as plastic waste goes almost everywhere, and as it does not disappear, a problem of planetary dimensions has emerged, and it is quite difficult to imagine how to scale

it back down except by prohibition or radically lower production. While many environmental organizations and activists eagerly push in that direction, it holds little appeal for the many businesses that rely on cheap, disposable plastics to stay lucrative.

We can now understand why market and industry responses to plastic pollution and waste management differ so markedly. When it comes to managing waste, companies put their (market and industrial) worlds at the pinnacle of importance as they vie with each other to demonstrate the degree of attention they give to the problem. But when we turn to plastic, companies downplay the significance of their home worlds and their own agency (“unfortunately, it is limited what we can do right now”), putting the emphasis instead on the agency of governance and civic worlds (“recycling is important but it must be subsidized and incentivized by the government or by international organizations”) and on changing subjects’ habits in domestic worlds (“if only people would bring tote bags, use rice straws, and learn how to recycle”).<sup>24</sup>

Without claiming comprehensiveness, we have here several ways of formatting circular Cambodia that are at most partially congruent. A flat grid that makes visible a diverse array of problems by placing them side by side. A hierarchical format that prioritizes industry and market worths and renders other worlds more or less invisible. A low-key, day-to-day circular formatting of informal waste collectors who move between several kinds of worlds and worths but really just seek to get by. And a plastic-related formatting where companies minimize their room for maneuver to keep their existing worlds and worths intact. What, if anything, does this add up to?

### UNCOMMON CIRCULAR WORLDS

To get “down to earth,” Bruno Latour (2018, 94) wrote that it is first necessary to “generate alternative descriptions.” With this in mind, I embarked on a tour of some Cambodian mind- and landscapes, where subjects, objects, and practices are currently, tentatively, being shifted toward circularity. As circulating objects weave in and out of different worlds, they become affiliated with diverse worths; but in the same process, they redistribute agency among their inhabitants. Thus, some plastic bags change from disposable rubbish into fashion objects and some coconut husks turn into organic compost that gives shape to an environmental community.

Where various worlds are co-present, the relative significance of worlds and their worths are tested. Those tests, too, are anchored in incongruent descriptions

of circulating objects, of why and how they need to change, and of who is responsible. Some want to recycle, some are missing a business portfolio, and some worry about the low quality of locally sourced plastic pellets. Some want to grow green brands, some want to build incinerators, and others worry about losing income if Styrofoam is outlawed. Later, relations between worlds and worths are formatted in reports and events. As they materialize in distributed practices, some of these formats begin to gain reality. They are scaling up. Many others fail to materialize, move nowhere, and are soon forgotten. The national strategy maps the circular problem space as an open-ended grid, while Waste Summit 2020 constructs a hierarchy with industry and market worlds on top. When it comes to plastic, market and industry representatives prefer to take a backseat and leave the action to government and citizens.

If these exhibits of changing relational constellations—of worlds and worths—should have any claim on your attention, it is not least because they provide alternatives to what is often presented as self-evident oppositions. From one side, formal circular agendas are usually depicted as sparkling win-win situations that will solve all kinds of economic, social, and environmental ills. From another, the entire panorama boils down “in the end” to business as usual, co-optation, or greenwashing. Somewhere in the vicinity of environmentality one will usually encounter the notion that *any* green development is quasi-determined by nebulous power-knowledge structures. In lieu of these unsatisfying oppositions, this travelogue of circulating objects has tried to make some finer-grained contrasts available for inspection.

This has involved no overall critique of scalability (compare [Tsing 2012](#)). Given that applied metaphysics sees everybody as continuously involved in making scales that preserve or seek to elevate their own worlds and worths, such a critique makes no sense *in general*. What matters are the specifics of how those scales are articulated and materialized. For example, the diverse circular issues discursively placed next to one another in the national strategy and action plan will undoubtedly be transformed into a prioritized set of material projects later on. At that moment, attentiveness to how this is done, and with which consequences, will become important. It is similarly important to point to the lacunae of circular diversity in Waste Summits past and future and to hold plastic reliant companies to account for their slippery attitude with respect to the problems they keep causing. This matters for articulating the tensions and lines of alignment between circular worlds, as well as for creating space for circular variety. If circularity is a patchwork effect of multidirectional movements between uncommon worlds, its



divergent potentials are obstructed by visions of the circular economy as a single integrated system guided exclusively by industrial and market worths.

Worlds can scale up but they can also scale down. From early 2020, Cambodian circular worlds have lived under the shadow of COVID-19. As most things went on standby, tourism and the service economy were decimated, and while air pollution decreased during lockdowns, the pandemic became a major plastic-pollution event (Eitel 2020). Numerous small-scale circular operations disappeared, but some lingered on, and began to make comebacks in 2022. As much as by high-profile environmental governance and industrial dreams, circular Cambodia thus continues to be shaped by background events and the “white noise of chronicity” (Tironi 2018, 452). Those silent transformations are as important for the possible emergence of green, uncommon worlds as the spectacles that mostly take center stage.

### ABSTRACT

*Across the planet, the circular economy has grown into a complex governance agenda. This is also the case in Cambodia, where various formal and informal circular activities have recently coalesced into new arrangements. However, much more is at stake than questions of economic governance. By tracing the circulation of diverse objects between practices guided by different worths and correspondingly variable enactments of circularity, the present travelogue exhibits circular worlds in tension. The relative significance of these worlds and worths is negotiated and tested at sites where representatives of many worlds are present. Later, some circular formats materialize in distributed practices, scale up, and gain in reality. Others linger in the shadows, obstructed by visions of the circular economy as a single integrated system. This exercise in applied metaphysics elicits circularity and its diverse potentials as patchwork effects of circulations between uncommon worlds. [circular worlds; plastic scale-making; uncommons; waste; worths]*

### NOTES

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1. See <https://www.khmertimeskh.com/50550580/shift-to-circular-economy-needed-to-tackle-waste-woes/> (consulted April 21, 2022).
2. The following is based on a mix of outdoor observations in the streets of Phnom Penh and indoors at (physical and virtual) public events. They are complemented by assorted informal conversations, news reports, and available gray literature collected over the past several years. Many descriptions are kept purposefully vague, both to protect informants (fictionalization as a matter of decency, as argued by Richard Rottenburg [2009, xviii]) and because the primary object of the essay is descriptive and conceptual rather than evaluative and/or critical. Wherever feasible (and sensible), observed events and

- concrete conversations have been repacked as aggregate descriptions with a view to articulating the “cumulative characteristics” of practices, events, and situations.
3. A thematically related but different form of inquiry, which investigates societies through practices of waste and disposal, is known as “garbology.” For other relevant studies of waste, see, for example, [Alexander and Reno 2012](#), [Lepawsky 2018](#), [Liboiron 2021](#), and [Strasser 2000](#).
  4. Arjun Appadurai’s regimes of value differ from [Zsuzsa Gille’s \(2010\)](#) similar-sounding “waste regimes,” which consist of social institutions and conventions for the production and regulation of waste. According to Gille, this mode of analysis makes it possible to deal with the “macro-level.” From the point of view of scale-making adopted here, the very idea of a macro-level looks quite different (see also [Jensen 2017](#)).
  5. Without committing to ANT terminologies or procedures, several anthropologists working in the same general area exhibit similarly open-ended tendencies (e. g., [Guyer 2004](#); [Maurer 2005](#)).
  6. In some sense, the term *worth* doesn’t seem very different from *value*. However, it marks the central distinction between an exclusive and reductive emphasis on market or monetary values and explorations of divergent worths/values that are in play and tension.
  7. Developed roughly in parallel, these studies were not in communication with Appadurai’s regimes of value.
  8. The possible emergence of a world of green worths is explored separately ([Lafaye and Thévenot 1993](#); see also [Latour 1998](#); [Blok 2013](#)).
  9. Of special note, [Gérard Jorland \(2000\)](#) describes an *ontology of value in motion* from Aristotle to the physiocrats and marginal utility theory until it eventually “vanished like a mirage . . . in a sense the victim of its own productivity” ([Daston 2000](#), 11).
  10. There are similarities with the boundary objects ([Star and Griesemer 1989](#)) that originated in pragmatist science and technology studies. But while boundary objects describe the capacity of particular objects to flexibly accommodate the practical requirements of diverse social worlds, the focus here is on reciprocal processes that inscribe objects with variable worths as they traverse practices, while modifying those worths or making available alternative ones (green ones, for example).
  11. Among other things, this includes the assumption that scales are domain-specific and determined by either nature (e.g., material reality) or by culture (e.g., social structures or power relations). This idea makes it seem as if phenomena, events, practices, and situations belong to, or have, specific scales (see [Jensen 2017](#)). At one end, favored by much ethnography, there are warm, fuzzy, and very interesting micro-interactions, which, alas, remain rather inconsequential in their own right and must therefore always be seen in light of “a big picture” or “broader context.” This broader context is often taken for granted, or merely alluded to, in the form of deterministic or hegemonic macro-structures.
  12. There is no contradiction between being committed to the performativity of all practices and speaking of more or less green or circular practices in the same breath. One can, for example, use obviously loaded terms like *greenwashing* not because one naively thinks that it offers an objective, value-neutral description, or due to unawareness that the practices thus named perform a palette of varied effects, but because one’s situated aim and preference is to highlight just those problematic aspects of those practices with a view to challenging or shifting them. Thanks to one of the anonymous reviewers for the opportunity to clarify this important point.
  13. See <http://www.csaro.org/page.php?mainid=21&sub1=27> (accessed April 21, 2022).
  14. See <http://www.csaro.org/page.php?mainid=55&sub1=56> (accessed April 21, 2022).
  15. See <http://www.csaro.org/page.php?mainid=55&sub1=63> (accessed April 21, 2022).
  16. See <https://igg.me/at/funkyjunk/x#/> (accessed April 21, 2022).
  17. See <http://www.funkyjunkrecycled.com/where-to-buy/4590930301> (accessed May 5, 2020; the page, and apparently the enterprise, has since disappeared).
  18. Chip Mong Insee forms part of the large, diversified Chip Mong Group, the construction arm of which has been criticized for using “blood bricks” made under hazardous

conditions by families deep in debt (Brickell, Parsons, Natarasjan, and Chann 2019). Those bricks feed the material itineraries of Phnom Penh and Sihanoukville's construction boom (Jensen 2021a, 2022). That one side of Chip Mong pursues green agendas while another involves debt slavery exemplifies that highly different worths and agendas can live under the same broad roof.

19. See <https://gggi.org/country/cambodia/> (accessed April 21, 2022).
20. The absence of local NGOs has varied sources. Civil society in Cambodia is generally repressed, and criticism is mainly voiced by internationals. Moreover, waste management and plastic pollution fall outside the usual environmental purview of many local NGOs. An exception is the Think Plastic campaign, which is run as a Facebook page and currently has more than 120,000 followers.
21. As explained in note 2, these paragraphs bundle and condense statements and arguments illustrative of the co-presence and tensions between different worths.
22. Named after the first chancellor of the Federal Republic of Germany, this political foundation promotes "freedom, liberty, peace, and justice" on the basis of right-leaning Christian democratic values. It currently runs projects in 120 countries, including in Cambodia (<https://www.kas.de/en/about-us>; consulted April 21, 2022).
23. Paraphrased from Figure 4, "Summary of Challenges to a Circular Economy," in the "Circular Economy Strategy and Action Plan" published by the Cambodian Ministry of the Environment in 2021.
24. Max Liboiron (2021, 75) has discussed GAIA's scathing critique ([https://www.noburn.org/wp-content/uploads/Technical\\_critique\\_Stemming\\_the\\_Tide\\_report.pdf](https://www.noburn.org/wp-content/uploads/Technical_critique_Stemming_the_Tide_report.pdf)) of the report "Stemming the Tide" (<https://oceanconservancy.org/wp-content/uploads/2017/04/full-report-stemming-the.pdf>), which recommended building incinerators in Southeast Asia to mitigate marine plastic pollution. Neither Liboiron nor GAIA would be impressed with the scalar imagination on display at Waste Summit 2020. But while Liboiron has elsewhere memorably likened plastic recycling to "putting a Band-Aid on gangrene" (<https://www.youtube.com/watch?v=QgLKojZ0dHW>), GAIA's first critique was that "Stemming the Tide" *disregards* local recycling efforts. For reasons that bring together geohistory, material agency, the need for shifted subjects, and the problematic of scale-making, it seems that both are right in their own way. As the organizer of the Think Plastic campaign, At Sotheavy, argues, there is no point in taking on the role of "plastic police," since Cambodia relies on lots of plastic products presently without good alternatives (<https://www.khmertimeskh.com/50814112/at-sotheavy-award-winning-anti-plastic-pioneer/>). Yet plastic pollution is omnipresent in Cambodia. In a context where the possibility of influencing big producers in foreign countries is practically nil, recycling and cleanups may matter—not because they will solve the issue, but as part of a broader green shift in practices and habits. (All links in this note consulted April 21, 2022.)

## REFERENCES

- Agrawal, Arun  
 2005 *Environmentality: Technologies of Government and the Making of Subjects*. Durham, N.C.: Duke University Press.
- Alexander, Catherine, and Joshua Reno, eds.  
 2012 *Economies of Recycling: The Global Transformation of Materials, Values, and Social Relations*. London: Zed.
- Appadurai, Arjun  
 1986 "Introduction: Commodities and the Politics of Value." In *The Social Life of Things*, edited by Arjun Appadurai, 3–64. Cambridge: Cambridge University Press.
- Blaser, Mario, and Marisol de la Cadena  
 2017 "The Uncommons: An Introduction." *Anthropologica* 59, no. 2: 185–93. <https://doi.org/10.3138/ANTH.59.2.T01>

- Blok, Anders  
 2013 "Pragmatic Sociology as Political Ecology: On the Many Worths of (Nature)s." *European Journal of Social Theory* 16, no. 4: 492–510. <https://doi.org/10.1177/1368431013479688>
- Boltanski, Luc, and Laurent Thévenot  
 2006 *On Justification: Economies of Worth*. Translated by Catherine Porter. Princeton, N.J.: Princeton University Press.
- Boulding, Kenneth  
 1966 "The Economics of the Coming Spaceship Earth." In *Environmental Quality in a Growing Economy*, edited by Henry Jarrett, 3–14. Baltimore, Md.: Johns Hopkins University Press.
- Brickell, Katherine, Laurie Parsons, Nithya Natarajan, and Sopheak Chann  
 2019 "Blood Bricks: Untold Stories of Modern Slavery and Climate Change from Cambodia." Essays. *Society + Space*. March 27.
- Çalışkan, Koray, and Michel Callon  
 2009 "Economization, Part 1: Shifting Attention from the Economy towards Processes of Economization." *Economy and Society* 38, no. 3: 369–98. <https://doi.org/10.1080/03085140903020580>
- Callon, Michel, ed.  
 1998 *The Laws of the Markets*. Oxford, U.K.: Blackwell.
- Daston, Lorraine  
 2000 "The Coming into Being of Scientific Objects." In *Biographies of Scientific Objects*, edited by Lorraine Daston, 1–15. Chicago: University of Chicago Press.
- Eitel, Kathrin  
 2020 "PlastiCorona: Who Cares about *That Waste?*" *Social Anthropology* 28, no. 2: 261–62. <https://doi.org/10.1111/1469-8676.12894>  
 2021 "Oozing Matters: Infracycles of 'Waste Management' and Emergent NatureCultures in Phnom Penh." *East Asian Science, Technology, and Society* 15, no. 2: 135–52. <https://doi.org/10.1080/18752160.2021.1896123>  
 2022 *Recycling Infrastructures in Cambodia: Circularity, Waste, and Urban Life in Phnom Penh*. New York: Routledge.
- Ellen MacArthur Foundation  
 2013 *Towards the Circular Economy. Vol. 2, Opportunities for the Consumer Goods Sector*. Isle of Wight, U.K.: Ellen MacArthur Foundation.
- Gabrys, Jennifer  
 2014 "Programming Environments: Environmentality and Citizen Sensing in the Smart City." *Environment and Planning D: Society and Space* 32, no. 1: 30–48. <https://doi.org/10.1068/d16812>
- Geissdoerfer, Martin, Paulo Savaget, Nancy M. P. Bocken, and Eric Jan Hultink  
 2017 "The Circular Economy: A New Sustainability Paradigm?" *Journal of Cleaner Production* 143: 757–68. <https://doi.org/10.1016/j.jclepro.2016.12.048>
- Gille, Zsuzsa  
 2010 "Actor Networks, Modes of Production, and Waste Regimes: Reassembling the Macro-Social." *Environment and Planning A* 42, no. 5: 1049–64. <https://doi.org/10.1068/a42122>
- Grimm, Nancy B., Stanley H. Faeth, Nancy E. Golubiewski, Charles L. Redman, Jianguo Wu, Xuemei Bai, and John M. Briggs  
 2008 "Global Change and the Ecology of Cities" *Science* 319, no. 5864: 756–60. <https://doi.org/10.1126/science.1150195>
- Guyer, Jane  
 2004 *Marginal Gains: Monetary Transactions in Atlantic Africa*. Chicago: University of Chicago Press.
- Haraway, Donna  
 2004 "The Promises of Monsters: A Regenerative Politics for Inappropriate/d Others." In *The Haraway Reader*, 63–125. New York: Routledge.

- Jensen, Casper Bruun  
 2017 “Mekong Scales: Domains, Test Sites, and the Uncommons.” *Anthropologica* 59, no. 2: 204–15. <https://muse.jhu.edu/article/676720>  
 2019 “Here Comes the Sun? Experimenting with Cambodian Energy Infrastructures.” In *Infrastructure, Environment, and Life in the Anthropocene*, edited by Gregg Hetherington, 216–36. Durham, N.C.: Duke University Press.  
 2021a “Phnom Penh Kaleidoscope: Construction Boom, Material Itineraries, and Changing Scales in Urban Cambodia,” *East Asian Science, Technology, and Society* 15, no. 2: 211–33. <https://doi.org/10.1080/18752160.2021.1896103>  
 2021b “Practical Ontologies, Redux.” *Berliner Blätter* no. 84: 77–91. <https://doi.org/10.18452/22974>  
 2022 “Emerging Potentials: Times and Climes of the Belt and Road Initiative in Cambodia and Beyond,” *East Asian Science, Technology, and Society* 16, no. 2: 206–29. <https://doi.org/10.1080/18752160.2021.1927937>
- Jorland, Gérard  
 2000 “The Coming into Being and Passing Away of Value Theories in Economics (1776–1976).” In *Biographies of Scientific Objects*, edited by Lorraine Daston, 117–32. Chicago: University of Chicago Press.
- Knox, Hannah  
 2020 *Thinking Like a Climate: Governing a City in Times of Environmental Change*. Durham, N.C.: Duke University Press.
- Kopytoff, Igor  
 1986 “The Cultural Biography of Things: Commoditization as Process.” In *The Social Life of Things*, edited by Arjun Appadurai, 64–95. Cambridge: Cambridge University Press.
- Lafaye, Claudette, and Laurent Thévenot  
 1993 “Une justification écologique? Conflits dans l'aménagement de la nature” [An Ecological Justification? Conflicts in the Management of Nature]. *Revue Française de Sociologie* 34, no. 4: 495–524.
- Latour, Bruno  
 1998 “To Modernize or to Ecologize? That’s the Question.” In *Remaking Reality: Nature at the Millennium*, edited by Noel Castree and Bruce Braun, 221–42. New York: Routledge.  
 2000 “On the Partial Existence of Existing and Nonexisting Objects.” In *Biographies of Scientific Objects*, edited by Lorraine Daston, 247–70. Chicago: University of Chicago Press.  
 2018 *Down to Earth: Politics in the New Climatic Regime*. Cambridge: Polity.
- Lepawsky, Josh  
 2018 *Reassembling Rubbish: Worlding Electronic Waste*. Cambridge, Mass.: MIT Press.
- Liboiron, Max  
 2013 “Plasticizers: A Twenty-First-Century Miasma.” In *Accumulation: The Material Politics of Plastic*, edited by Jennifer Gabrys, Gay Hawkins, and Mike Michael, 134–49. New York: Routledge.  
 2021 *Pollution is Colonialism*. Durham, N.C.: Duke University Press.
- Maurer, Bill  
 2005 *Mutual Life, Limited: Islamic Banking, Alternative Currencies, Lateral Reason*. Princeton, N.J.: Princeton University Press.
- Mohácsi, Gergely  
 2021 “Toxic Remedies: On the Cultivation of Medicinal Plants and Urban Ecologies.” *East Asian Science, Technology, and Society* 15, no. 2: 192–210. <https://doi.org/10.1080/18752160.2021.1897738>
- Morita, Atsuro, and Kazutoshi Tsuda  
 2022 “Fab Cities as Infrastructures for Ecological Reparation: Maker Activism, Vernacular Skills, and Prototypes for Self-Grounding Collective Life.” In *Ecological Reparation: Repair, Remediation, and Resurgence in Social and Environmental Conflict*,

- edited by Dimitris Papadopoulos, Maria Puig de la Bellacasa, and Maddalena Tacchetti. Bristol: Bristol University Press.
- Newell, Joshua P., and Joshua Cousins  
 2014 "The Boundaries of Urban Metabolism: Towards a Political-Industrial Ecology." *Progress in Human Geography* 39, no. 6: 702–28. <https://doi.org/10.1177/0309132514558442>
- O'Neill, Kate  
 2019 *Waste*. Cambridge, U.K.: Polity.
- Pearce, David W., and R. Kerry Turner  
 1989 *Economics of Natural Resources and the Environment*. Brighton, U.K.: Harvester Wheats.
- Raworth, Kate  
 2017 *Doughnut Economics: Seven Ways to Think Like a Twenty-First Century Economist*. New York: Random House.
- Rottenburg, Richard  
 2009 *Far-Fetched Facts: A Parable of Development Aid*. Cambridge, Mass.: MIT Press.
- Smith, Barbara Herrnstein  
 1991 *Contingencies of Value: Alternative Perspectives for Critical Theory*. Cambridge, Mass.: Harvard University Press.
- Stahel, Walter R., and Geneviève Reday-Mulvey  
 1976 *The Potential for Substituting Manpower for Energy*. Report to the Commission of the European Communities. Geneva: Battelle, Geneva Research Centre.
- Star, Susan Leigh, and James R. Griesemer  
 1989 "Institutional Ecology, 'Translations,' and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology." *Social Studies of Science* 19, no. 3: 387–420. <https://doi.org/10.1177/030631289019003001>
- Stengers, Isabelle  
 2018 "Autonomy and the Intrusion of Gaia." *South Atlantic Quarterly* 116, no. 2: 381–400. <https://doi.org/10.1215/00382876-3829467>
- Strasser, Susan  
 2000 *Waste and Want: A Social History of Trash*. New York: Holt.
- Swyngedouw, Erik  
 2006 "Circulations and Metabolisms: (Hybrid) Natures and (Cyborg) Cities." *Science as Culture* 213, no. 3: 105–21. <https://doi.org/10.1080/09505430600707970>
- Szerszynski, Bronislaw, and Nigel Clark  
 2020 *Planetary Thought: The Anthropocene Challenge to the Social Sciences*. Cambridge: Polity.
- Thompson, Michael  
 1979 *Rubbish Theory: The Creation and Destruction of Value*. Oxford: Oxford University Press.
- Tironi, Manuel  
 2018 "Hypo-interventions: Intimate Activism in Toxic Environments." *Social Studies of Science* 48, no. 3: 438–55. <https://doi.org/10.1177/0306312718784779>
- Tsing, Anna Lowenhaupt  
 2012 "On Nonscalability: The Living World Is Not Amenable to Precision-Nested Scales." *Common Knowledge* 18, no. 3: 505–24. <https://muse.jhu.edu/article/485828>
- Volk, Tyler  
 2004 "Gaia Is Life in a Wasteland of By-Productions." In *Scientists Debate Gaia: The Next Century*, edited by Stephen H. Schneider, James R. Miller, Eileen Crist, and Penelope Boston, 27–36. Cambridge, Mass.: MIT Press.
- Winans, K., A. Kendall, and H. Deng  
 2017 "The History and Current Application of the Circular Economy Concept." *Renewable and Sustainable Energy Reviews* 68: 825–33. <https://doi.org/10.1016/j.rser.2016.09.123>

Wolman, Abel

1965 “The Metabolism of Cities.” *Scientific American* 213, no. 3: 179–90. <https://doi.org/10.1038/scientificamerican0965-178>

Zhang, Amy

2020 “Circularity and Enclosures: Metabolizing Waste with the Black Soldier Fly.” *Cultural Anthropology* 35, no. 1: 74–103. <https://doi.org/10.14506/ca35.1.08>