

Overview Review

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Current and future approaches to shifting businesses towards plastic-free packaging systems based on reduction and reuse

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Abstract

The fate of plastics and packaging are intimately connected; plastics revolutionised the world of packaging, and today, packaging is plastics' biggest market. However, as awareness of plastics' negative human and environmental impacts grows, policymakers, civil society and industry are seeking alternatives to plastic packaging as a pathway to reducing plastics production, waste and pollution. The shortcomings of recycling, lightweighting and material substitution strategies has turned attention to source reduction strategies up the waste hierarchy. These strategies transform products, business models and supply chains to prevent packaging altogether or accommodate reusable packaging systems. As these are radical changes from business-as-usual, widespread industry uptake has not been forthcoming. This review highlights three categories of current and potential approaches to incentivising businesses to adopt plastic-free packaging systems based on reduction and reuse: persuasion, legislation and enabling measures. Predominant persuasive approaches based on voluntarism are not delivering desired results under current policy settings and could be more successful if combined with legislative reform to level the economic playing field between single-use and reuse. Additionally, enabling measures that fill practical and infrastructural system-level gaps could help to accelerate and coordinate uptake of effective and efficient unpackaged or reusable packaging systems.

Impact statement

Plastic pollution and packaging are daily, visible issues that impact human and environmental health and concern many people. This review article summarises what is known about the potential role plastic-free packaging systems based on reduction and reuse can play in reducing plastics production and pollution. These systems include innovations that can be adopted by producers and retailers to prevent packaging altogether or reinstate reusable packaging systems. The article outlines research that describes these systems, highlights the growing academic and civil society consensus that they can reduce plastics production and pollution, explains the barriers to getting them up and running and sets out the different approaches to supporting or requiring industry to overcome barriers to adopting these new packaging systems at scale. The latter may be especially useful for policymakers.

Introduction

Plastics production, use and disposal is transgressing planetary boundaries and impacting human and environmental health (Macleod et al., 2021; Persson et al., 2022). Suggested responses range from improving plastic waste management and recycling, replacing single-use plastics with alternative materials and systems, to capping global plastics production and consumption (Lau et al., 2020; Bergmann et al., 2022). Packaging is plastics' biggest market and contributes a disproportionately large share of plastic waste and pollution (Sherrington, 2016; Geyer, 2020; Morales-Caselles et al., 2021). Addressing plastic packaging has therefore gained increased attention from policymakers, NGOs, businesses and citizens striving for a safe, circular economy without plastic pollution (Hafsa et al., 2022). Circular economy and zero waste theory generally emphasise 'source reduction' responses as most effective for reducing waste, resource depletion, emissions and pollution associated with products (Lugo et al., 2020; Moss et al., 2022; Diprose et al., 2023; Patreau et al., 2023).

Source reduction approaches to plastic packaging include preventing unnecessary use of packaging (across material types) and reducing the overall number of packaging units put to market, via circular business models, like refill and reuse systems. Real-world examples of these are currently mostly niche. Mass adoption requires widespread industry transition from linear to

circular business models, which is unlikely to occur spontaneously. This review article outlines the current state of knowledge regarding the necessity of this transition and strategies to realise it. It contains three parts: (1) an overview of the relationship between plastics production and packaging, (2) discussion of the rise of source reduction as a proposed strategy for curtailing plastics in the packaging system and (3) description of current or potential measures for incentivising/requiring businesses to adopt alternative plastic-free packaging systems based on reduction and reuse.

The review drew upon a targeted scan of academic literature on Google Scholar, a grey literature search on Google, and the pre-existing knowledge of the author, who undertakes reusable packaging research. Grey literature was included to expand the available source material because packaging-free and reusable packaging systems, along with potential measures to increase their uptake, are nascent fields of academic study (albeit growing). Keyword searches combined terms such as 'packaging', 'reusable packaging', 'unpacked', 'packaging-free', 'refillable', 'plastic packaging' and 'packaging waste', with terms such as 'plastic pollution', 'single-use', 'product stewardship', 'extended producer responsibility', 'regulation', 'legislation', 'policy', 'incentives', 'economic incentives', 'command and control', 'rewards', 'targets', 'bans', 'levies', 'subsidies', 'behaviour change', 'zero waste', 'circular economy', 'prevention', 'source reduction' and 'reuse'. Only sources in English were included. Sources underwent a preliminary scan to determine whether they contained substantial discussion of reuse/refill packaging systems, and/or discussed specific measures for reducing plastic packaging or increasing uptake of reuse/refill systems. A date-based exclusion criterion was deemed unnecessary, as the majority of literature on reusable or refillable packaging has been published within the last 10 years (Bradley and Corsini, 2023).

The interdependent fate(s) of plastics and packaging

Plastics and packaging have a historically symbiotic relationship, highlighted by Hawkins' (2018) description of plastics as 'the skin of commerce'. Plastics' ability to form a cheap, versatile protective carrier for almost any product imaginable, revolutionised packaging in the mid-twentieth century. Over subsequent decades, plastic packaging facilitated the development of complex, global supply chains and new products, whose existence today locks-in ongoing demand for plastic packaging (Diprose et al., 2023). The plastics–packaging symbiosis has allowed both partners to enjoy decades of successful growth together. However, their interlocking fate suggests any fall from grace may also be mutual.

Today, the social licence for unfettered plastics usage is eroding. A growing body of scientific knowledge is verifying that plastics release various pollutants across their lifespan, negatively impacting humans and other living organisms, ecosystems, biodiversity and the climate (Thompson et al., 2009; Hamilton and Feit, 2019; Lau et al., 2020; Bergmann et al., 2022; Lorang et al., 2022, 92; OECD, 2022b). These pollutants include plastic waste in landfills, incinerated or in the natural environment; emissions produced when oil is extracted, refined and turned into polymers and products; and chemical additives and microplastics that can leach from plastic products while in use and following disposal. Recent studies also suggest that the scale and linear nature of plastics production, use and disposal is pushing humanity outside the safe planetary operating space, contributing to overshoot of the novel entities planetary boundary (Persson et al., 2022) and consuming an increasing share of the remaining carbon budget (Hamilton and

Feit, 2019; OECD, 2022b). Staying below 1.5°C of global warming could require plastics consumption to drop by 75% per capita by 2050 (Hann et al., 2022). However, on current trajectories, plastics production will triple from 2019 levels by 2060 (OECD, 2022b; see also Lau et al., 2020). This untenable growth trajectory must be reversed (Lau et al., 2020; Hann et al., 2022), with Bergmann et al. (2022) advocating a cap on production to ensure absolute reductions.

One logical pathway for realising dramatic reductions is to decrease reliance on plastics for the purposes to which plastics are currently put. Such an inquiry automatically spotlights packaging. Packaging is plastics' single biggest market, consuming 36% of global plastics production (Geyer, 2020), and roughly 4% of world oil production (Thompson et al., 2009, 2153). Downstream packaging contributes a disproportionately large 46% of total plastic waste generation (Geyer, 2020), and is a primary contributor of plastic pollution in the natural environment (Sherrington, 2016; Morales-Caselles et al., 2021). Packaging's ubiquity also makes it a potential vector for harmful chemical additives into the human population (Muncke et al., 2020). The OECD (2022b, 26) has earmarked packaging as one of three sectors that will drive strongest projected growth in plastics production by 2060.

Packaging's ongoing contribution to rates of plastics production and waste relates to the speed with which it moves through the economy, as a mostly single-use, short-lived product (Geyer et al., 2017, 23; Rubio et al., 2019, 218; OECD, 2022b, 84). These factors, combined with its light weight, exacerbate its propensity to leak into the environment, and strongly suggest that efforts to reduce the number of packaging units on the market and increase packaging lifespans by disrupting single-use systems could help to stem both demand for plastics and plastic waste generation.

From neglect to recognition: source reduction strategies to address plastic packaging

Evidently, while plastic packaging has performed many useful functions, it also carries numerous 'shadow responsibilities' that extend beyond intended functions and have become impossible to ignore (Hawkins, 2020, 409):

The plastic package is no longer a ubiquitous market device, it is connected to a range of new actants – waste streams, anti-plastic activism, oceans, choking animals – that reveal other characteristics of its social life, challenge existing accountability relations, and provoke new responsibilities and identities for the package.

As awareness of these problems have grown, so have efforts to identify and implement mitigations. These can be targeted upstream (pre-consumption) or downstream (post-consumption) (Lau et al., 2020). Traditionally, practical efforts have focused on downstream actions, such as recovering packaging for recycling, improving plastic waste management and clean-up campaigns (Massarutto, 2014; Tencati et al., 2016; Kunamaneni et al., 2019; Rubio et al., 2019; Tangpuori et al., 2020; Bocken et al., 2022; Global Plastics Policy Centre, 2023, 19). Until recently, academic commentary on suggested measures to address plastic pollution has also often emphasised recycling, waste management and even waste-to-energy (Lohr et al., 2017; Thompson et al., 2009; cf. Lau et al., 2020). These trends are not unique to packaging, and reflect the dominant approach for most waste streams (Bartl, 2014).

Where upstream prevention has been considered, actions often constellate around narrowly framed single-use plastic bans, consumer-focused campaigns to refuse plastics or voluntary

industry initiatives (Schnurr et al., 2018; Tangpuori et al., 2020; Dixon and Gefßner, 2022; OECD, 2022a). These actions often generate prevention strategies at the material, rather than product, level (e.g., lightweighting packages to reduce material intensity, or substituting plastics with other materials, such as paper, glass or metals) rather than methods that fundamentally alter packaging or business models to reduce individual packaging units put to market (Worrell and van Sluisveld, 2013; Massarutto, 2014, 14; Kunamaneni et al., 2019; Rubio et al., 2019, 225–226; Coelho et al., 2020a, 2; Bocken et al., 2022, 4; EMF, 2022; Wildwistle, 2022; Bradley and Corsini, 2023). In 2016, Tencati et al. reviewed packaging prevention policies in 11 countries identified as leaders in this area. Even amongst these jurisdictions, prevention policies were often voluntary, involved targeted consumer information campaigns or were non-specific about how packaging reductions should be achieved. The authors highlighted very few policies focused on innovating product delivery methods or packaging reusability, noting ‘incentive policies for reuse of packaging are not commonly adopted’ (42).

Retrospective analyses of the commonly-applied approaches to reduce and recycle plastic packaging to date suggest that while they can produce material efficiency gains, these are outstripped by growth in plastics and packaging production, waste and pollution (Worrell and van Sluisveld, 2013; Tencati et al., 2016; Rubio et al., 2019, 218; Bergmann et al., 2022; Bocken et al., 2022; EMF, 2022, 18). Plastic packaging recycling presents ‘a major bottleneck’ (Lorang et al., 2022, 101); low recovery rates and technical capacity and capability gaps mean recycling cannot effectively displace virgin materials nor ensure closed-loop recycling of plastic packaging into more plastic packaging (Bartl, 2014, 7–8, 100–101; WEF and Kearney, 2021; Lorang et al., 2022; Global Plastics Policy Centre, 2023, 19). Even if recycling bottlenecks can be overcome, emerging research suggests that recycled food and beverage contact material increases potential exposure to hazardous substances, which themselves can also inhibit recyclability (Geueke et al., 2018; Gerassimidou et al., 2022; Johansson, 2023).

Lightweighting and material substitution can exacerbate these issues if they reduce downstream recyclability, for example, use of plastic pouches or compostable plastics over more readily recycled containers made of conventional polymers (Tangpuori et al., 2020, 38). Furthermore, simply swapping plastics in disposable packaging for other materials does not remove the environmental burdens of the extractive, ‘take, make, dispose’ single-use system, in which most materials produce adverse outcomes (Gordon, 2021; UNEP, 2021; Jacobsen et al., 2022, 64; Global Plastics Policy Centre, 2023, 19). Also, material substitutes are not necessarily always ‘safer’. For example, compostable packaging not only presents logistical challenges for collection and processing, it also risks contaminating soils with harmful and persistent pollutants (Wildwistle, 2022, 1–2).

As mainstream actions have not created desired reductions in material extraction, production or toxicity, some commentators have begun exploring the potential to combine downstream initiatives with more radical upstream actions. These involve redesigning how products are made and consumed, with a focus on transforming business models to enhance prevention, reduction and reuse activities, that is, ‘source reduction’ (Worrell and van Sluisveld, 2013, 1; Lau et al., 2020; The Pew Charitable Trusts and SystemIQ, 2020; WEF and Kearney, 2021; Bocken et al., 2022; Hann et al., 2022; Lorang et al., 2022, 100). For packaging, source reduction involves eliminating unnecessary packaging altogether, or replacing single-use packaging with reusable packaging systems via new circular business models (Tencati et al., 2016; Lendal and

Wingstrand, 2019; EMF, 2020; Gordon, 2021; Bocken et al., 2022; Long et al., 2022; Patreau et al., 2023).

Packaging prevention or reuse systems are heterogeneous. They can be arranged in various ways, along different points of the supply chain, and require differing levels of investment, commitment and logistical complexity; and are described using taxonomies and terminology with varying degrees of technicality and consistency (Lofthouse et al., 2009; Beitzen-Heineke et al., 2017, 1528–1529; Lendal and Wingstrand, 2019, 12–21; Marken and Horisch, 2019, 167; Coelho et al., 2020a, 3; Coelho et al., 2020b, 12–13; EMF, 2020; Greenwood et al., 2021, 1689–1690; Bocken et al., 2022, 4; Kachook, 2022, 9–11; Moss et al., 2022; Schneider and Copello, 2022, 4; Diprose et al., 2023, 271–272; Global Plastics Policy Centre, 2023). At a high level, these systems can include:

- Redesigning products to avoid packaging altogether (e.g., toiletries in a bar rather than liquid form);
- Reformatting retail contexts and business models to support more sale of ‘loose’ products, for example, unpackaged produce or bulk dispensing systems, so consumers can fill their own containers or borrow empty containers provided at refill stations;
- Pre-filling/pre-packing products into durable packages that businesses take back, prepare for reuse through sanitisation and/or repair and then repack/replenish with the same or similar type of product, so that the packages complete multiple cycles, displacing equivalent numbers of single-use packages. These systems can include consumer-facing packages (e.g. reusable bottles for beverages) and business-to-business packages (e.g. returnable kegs for hospitality beverages, or reusable secondary and tertiary transport packaging like pallets or crates).

While unpackaged and reusable packaging systems are often material agnostic, for advocates of plastic-free systems, the preferred materials for reusable packages could be glass, ceramic, metal or wood.

The benefits of a source reduction approach to plastic packaging over a material substitution or recycling-first approach reflects the logic of the waste hierarchy and circular economy theory (Coelho et al., 2020a, 1–2; Lugo et al., 2020; Greenwood et al., 2021, 1688; Dixon and Gefßner, 2022, 2; Moss et al., 2022; Wildwistle, 2022, 3; Diprose et al. 2023, 270–271; Patreau et al., 2023). The waste hierarchy sits at the core of zero waste/waste minimisation/waste management approaches, and features in numerous laws, strategies and policy documents relating to waste and packaging, globally. It prioritises source reduction approaches as more resource efficient (i.e., more effective at reducing both waste and greenhouse gas emissions) than lower-order activities, such as recycling (Bartl, 2014, 3–5; Diprose et al., 2023, 270–271). Similarly, circular economy theory prioritises business models that reflect small, closed loops, such as reuse, which keep products circulating in their original form, for their original purpose, in order to reduce demand on resource extraction and preserve a product’s value and embodied energy (Coelho et al., 2020a, 1; Blumhardt, 2023, 8–9).

Until recently, scepticism surrounded the potential of unpackaged/reusable packaging to displace plastic consumption and influence meaningful reductions in plastic pollution (see, e.g., Thompson et al., 2009). However, attitudes are shifting; influential NGOs have projected that reuse models could replace 20%–30% of single-use plastic packaging (Lendal and Wingstrand, 2019; The Pew Charitable Trusts and SystemIQ, 2020, 9–10), with even greater replacements possible for key target sectors and products,

like beverages, takeaway packaging, e-Commerce and transport packaging (Copello et al., 2021; WEF and Kearney, 2021, 5; Potting et al., 2022). This replacement effect is projected to translate into downstream reductions in plastic pollution (Schroerer et al., 2020; UNEP, 2022 62).

Lifecycle analyses (LCAs) have further strengthened the case for source reduction approaches to plastic packaging, finding that reusable packaging generally outperforms single-use packaging on most environmental measures, provided it is reused enough times to outweigh its initial manufacture and that of the single-use equivalents replaced (Coelho et al., 2020a, 7; Coelho et al., 2020b; Gordon, 2020; Zimmerman and Bliklen, 2020; Greenwood et al., 2021; UNEP, 2021, 2022; Bocken et al., 2022, 4). Accordingly, replacing single-use plastic packaging with systemic solutions like reusable packaging can help to deplasticise the packaging system, while mitigating potential increases in greenhouse gas emissions (or other environmental impacts) that the plastics industry commonly argues might otherwise result from simple material substitution scenarios (Farrelly et al., 2020).¹ However, it is important to note that the environmental benefits of reuse/refill packaging systems cannot be assumed; systems should be designed according to best practice to harness these benefits and avoid unintended consequences (Bradley and Corsini, 2023).

Approaches to shifting businesses towards plastic-free packaging systems based on reduction and reuse

Deplasticising the packaging system by moving up the waste hierarchy is a systemic change from business-as-usual, with social, economic and practical implications for producers, retailers, governments and consumers (Tencati et al., 2016, 36; Coelho et al., 2020a, 8; Hawkins, 2020; WEF and Kearney, 2021, 4; Prindiville, 2022; Bradley and Corsini, 2023; Global Plastics Policy Centre, 2023). Single-use packaging systems are deeply entrenched, and the market share of unpackaged/reusable packaging systems has shrunk dramatically since the 1950s (Coelho et al., 2020a, 2; Copello et al., 2021; Wilcox and Mackenzie, 2021; Bocken et al., 2022; EMF, 2022). Today's systems are often niche and lack economies of scale, translating to higher prices or increased inconvenience, which consumers may be reluctant to accept (Lofthouse et al., 2009; Coelho et al., 2020a, 9; Brown et al., 2022; Long et al., 2022; Moss et al., 2022; Bradley and Corsini, 2023; Patreau et al., 2023).

Returning to reuse will require radical reorganisation of producer and retailer business models, supply chain logistics and waste and resource recovery systems, which are currently designed for single-use packaging (Bartl, 2014, 12; Coelho et al., 2020a, 8; Hawkins, 2020; Bocken et al., 2022; Prindiville, 2022; Global Plastics Policy Centre, 2023). This will demand significant upfront capital expenditure in new infrastructure, logistics and retail settings (Coelho et al., 2020a, 8–9; Moss, 2021, 51; WEF and Kearney, 2021, 12; EMF, 2022, 23; Schneider and Copello, 2022, 7; Global Plastics Policy Centre, 2023). Local and national governments must also rethink dominant waste management and recycling-first approaches to packaging issues, which, along with the publically funded waste and recycling services

they produce, are complicit in perpetuating single-use plastic packaging systems (Kunamaneni et al., 2019; Diprose et al., 2023; Global Plastics Policy Centre, 2023, 38).

An additional complexity is that single-use plastic packaging has birthed consumer and business expectations that did not exist in reusable packaging's heyday. New unpackaged/reusable packaging systems must now contend with: an eye-watering array and diversity of products; modern, convenience-based lifestyles, retail and consumption practices that suit single-use models (e.g., smaller portion sizes, supermarket systems, takeaway culture and online shopping); and packaging's role as a key brand differentiator, which could obstruct the standardisation needed to ensure operational efficiency for reusable packaging systems (Worrell and van Sluiseveld, 2013, 7; Tencati et al., 2016, 35; Coelho et al., 2020a; WEF and Kearney, 2021; Brown et al., 2022; Jacobsen et al., 2022, 64). Seemingly unrelated policy areas, such as food safety and infection prevention control, can also create real or perceived conflicts with efforts to reduce or reuse packaging. If left unresolved, these conflicts can present an ongoing barrier to progress, or derail it entirely in the event of public health shocks, as seen with the disruption to plastic reduction policies during the COVID-19 pandemic (Silva et al., 2020). Modern business models also implicitly rely on socialising the costs of single-use packaging waste, which makes single-use packaging economically attractive. Therefore, while unpackaged/reusable packaging systems are likely cheaper for society overall, because the systems internalise previously externalised costs, key producer and retailer participants may have a vested interest in maintaining the status quo (Coelho et al., 2020a, 5–7; Long et al., 2022, 15).

Overcoming the obstacles to unpackaged/reusable packaging systems requires a multipronged approach. While individuals have a role to play and campaigns to shift consumer preferences are valid, consumers do not make packaging decisions and cannot drive systemic changes towards reduce and reuse unless these are viable, accessible alternatives to choose over single-use packaged equivalents; businesses must shift to implementing these alternatives, and strategies are needed to incentivise or require them to do so (Tangpuori et al., 2020, 152; Moss, 2021, 51; Long et al., 2022, 2). Several current and potential strategies have emerged in the grey and academic literature and in practice, which this article categorises as *persuasive*, *legislative* or *enabling*.

Persuasive approaches can be adopted by a wide group of actors, including governments, NGOs/civil society and industry. They are voluntary and help to create new norms that either trigger or bed-in binding measures. They can include information-provision, research, advocacy and campaigning, voluntary agreements and targets, cooperative support networks, grants/funding and piloting new packaging systems. *Legislative* actions are the purview of Governments (individually or multilaterally), and can include command and control measures (e.g., banning or mandating particular types of plastic packaging, setting packaging design standards or binding targets) and economic instruments (e.g. levies, subsidies and deposit/return systems) (Brouillat and Oltra, 2012). *Enabling* measures are complementary to the incentives generated by persuasive and legislative approaches. They seek to build the surrounding system conditions conducive to effective and efficient unpackaged and reusable packaging systems. They can include universal standard setting, and investment and procurement in necessary shared infrastructure and services. Enabling measures are most likely implemented by organisations with economic oversight, such as local or national governments and/or industry or sector groupings.

¹NB LCAs have yet to adequately factor many plastic pollution impacts beyond greenhouse gas emissions, including plastic leakage across the supply chain (see Woods et al., 2016; Hann, 2020; United Nations Environment Programme, 2022, 61). Therefore, they may underestimate plastic's impact relative to other materials (in both single-use and reuse contexts). However, discussion of this limitation goes beyond the scope of this paper.

The power of persuasion?

The persuasive strategy utilises voluntary, cooperative, promotional or information and awareness-raising measures to create new norms and influence and facilitate industry transition to new packaging practices. Voluntary agreements, programmes and product stewardship schemes initiated by industry groups, NGOs or public–private partnerships are a well-established means of targeting packaging waste, albeit having mostly focused on recycling (see Massarutto, 2014; Tencati et al., 2016; Tangpuori et al., 2020). Local and central government can direct such schemes towards source reduction outcomes by initiating, promoting or participating in third-party collaborations, public–private agreements or corporate programmes to redesign packaging or prevent packaging waste and facilitating cross-industry cooperation (Tencati et al., 2016, 42; Rubio et al., 2019, 225–226; Consumers Beyond Waste, 2021; WEF and Kearney, 2021, 4, 17–18). An influential example of a voluntary agreement with source reduction elements is the Ellen MacArthur Foundation’s New Plastics Economy Global Commitment, launched in 2018, and the adjoining Plastics Pact Network, in which hundreds of businesses, governments and organisations have committed to targets to investigate and implement packaging elimination and reusable packaging systems – with a headline commitment for all plastic packaging to be 100% reusable, recyclable or compostable by 2025 (Greenwood et al., 2021, 1689).

Another persuasive strategy is research, advocacy and information campaigns to identify solutions and guide and motivate new behaviours. Local and national governments can initiate programmes to raise corporate or public awareness about packaging prevention and reuse/refill systems or inform their own policy-making, via workshops, practical guidance, promoting eco-labelling or certification systems, or using LCA and other metrics (Tencati et al., 2016, 42–43; Rubio et al., 2019, 225–227; EMF, 2022, 23). Beyond government, a network of civil society and industry organisations have grown around the plastic-free, zero-waste, unpackaged and reuse movements, generating knowledge and advocacy to drive government policy and industry practice towards source reduction. Many of these groups have produced ‘diagnostic’, ‘how-to’ or ‘playbook’ reports that catalogue existing solutions to the plastic packaging problem, imagine future scenarios where niche unpackaged/reusable case studies become mainstream and accord actions to different responsible actors for implementing and scaling solutions (e.g., retailers/hospitality, product manufacturers, the packaging industry or local and national governments) (e.g., Buchanan, 2019; Lendal and Wingstrand, 2019; Miller et al., 2019; EMF, 2020; Greenpeace UK, 2020; Closed Loop Partners and Ideo, 2021; Consumers Beyond Waste, 2021; Gordon, 2021; Australian Packaging Covenant Organisation, 2022; Copello et al., 2022).

Over time, persuasive actions can set new expectations, reframe the possible, generate momentum and trigger action (Hawkins, 2020). Indeed, recent years have seen a marked increase in industry unpackaged/reusable packaging pilots, collaborations and support networks (e.g., EMF, 2022, 21; The Refill Coalition, 2022), and individual corporate commitments to reuse, such as Coca-Cola’s goal to package at least 25% of its global beverage production in refill/reuse formats by 2030 (The Coca-Cola Company, 2022). These developments reflect a desire to remain competitive and relevant in the shifting market (Massarutto, 2014, 18), and to persuade via ‘leading by example’. Governments, NGOs or industry associations can further reinforce this atmosphere through incubator and grant schemes for source reduction activities, and awards

for packaging innovation that promote prevention or reuse (Rubio et al., 2019).

Persuasive rather than prescriptive measures give space for industry innovation, while industry-oriented initiatives often focus on the pragmatics and opportunities of change, ‘without resorting to apocalyptic rhetoric or political accusations’ (Hawkins, 2020, 7). However, they can also produce targets and initiatives that are comfortably vague and unenforceable, permitting continuation of current business models. For example, many of the corporations that have individually committed to increase reusable packaging have not met previous self-proclaimed packaging targets (Tangpuori et al., 2020). Furthermore, like most voluntary initiatives, the Global Commitment contains no mechanism to enforce compliance, and its headline target (‘100% reusable, recyclable and compostable packaging by 2025’) merges reusables, recyclables and compostables, meaning it can be met without any gains in reuse (Moss et al., 2022). Indeed, successive Global Commitment progress reports have highlighted very low levels of corporate ambition, investment and progress on reuse. In 2021, total plastics usage across signatories grew, while reusable packaging declined to an average of 1.2%, and material substitution and lightweighting dominated signatories’ elimination/prevention interventions (EMF, 2022, 4).

Overall, persuasive actions are useful, but on their own are unlikely to generate meaningful shifts in business models that reduce plastics production and consumption. The World Economic Forum and Kearney (2021, 9–10) have highlighted the importance of public–private partnerships ‘to overcome scale barriers to reuse’. However, experience with voluntary extended producer responsibility/product stewardship (EPR/PS) schemes demonstrates that voluntary initiatives tend to be narrow in scope and struggle to elicit the participation rates needed for scale, efficiency or coordinated action (OECD, 2022a, 6.2.4). Indeed, despite being the leading global agreement in this area, the Global Commitment’s corporate signatories represent just 20% of the plastic packaging market (WEF and Kearney, 2021, 10), and many of the reuse pilots it has elicited ‘are fragmented and not embedded in a business strategy that could lead to reuse at scale’ (EMF, 2022, 4).

Furthermore, if persuasive actions are not well targeted, they risk funnelling finite resources down dead-ends that become their own barriers to progress, such as expensive and time-consuming research processes, or information/education campaigns that deflect responsibility to undeserving actors in the supply chain. The weaponisation of LCAs and the individualisation of responsibility for packaging are well-documented examples (Hann, 2020; Tangpuori et al., 2020). Urbanic (2021) has juxtaposed the growth of industry reuse pilots against the decreasing reusable packaging market share, and posited ‘endless piloting’ as a potential delay tactic. Tangpuori et al. (2020) have also itemised dozens of examples of industry groups co-opting voluntary plastic packaging initiatives to create a semblance of action, subduing public pressure and thus maintaining the status quo.

Undoubtedly, brokering public–private collaboration, encouraging industry solutions, researching, piloting well-designed unpackaged/reusable systems and generating consumer goodwill are all critical steps in de-transitioning from a reliance on single-use plastic packaging. However, without binding measures that engender widespread and enduring shifts in industry practices combined with enabling measures to support standardisation around best practice, public funds may be used inefficiently to support niche and uncoordinated unpackaged/reuse trials and infrastructure with no growth plan. Future approaches could be strengthened by situating persuasive actions within a binding regulatory and

economic framework established by Government actors with the intention of steering, necessitating and directly incentivising industry shifts.

A binding legislative framework for action

Studies on the impacts and efficacy of different packaging waste prevention laws are sparse (Tencati et al., 2016, 36–37; Coelho et al., 2020a, 10; Bradley and Corsini, 2023). However, there seems a broad consensus that current policy settings are insufficient and that Government regulatory and economic reform is needed to incentivise new business models, including industry shifts towards source reduction solutions to plastic packaging (Kunamaneni et al., 2019, 265; Lau et al., 2020, 6; Moss, 2021, 51; WEF and Kearney, 2021, 9; EMF, 2022, 23; OECD, 2022a; OECD, 2022b, 65). The argument is not that governments should establish and operate new packaging systems, but that governments have a unique power to progressively mandate such systems, phase-out problematic linear alternatives and correct market distortions so that otherwise niche source reduction packaging practices become economically attractive and thus more diffuse (see Massarutto, 2014, 19).

Reforms that could level the playing field between single-use and source reduction are detailed in grey literature (Coelho et al., 2020b; Consumers Beyond Waste, 2021, 2022; Copello et al., 2021, 2022; Gordon, 2021; WEF and Kearney, 2021, 25; Blumhardt, 2022; Maillot, 2022; OECD, 2022b), and academic sources on reusable packaging and EPR/PS (Brouillat and Oltra, 2012; Massarutto, 2014; Tencati et al., 2016; Rubio et al., 2019; Coelho et al., 2020a, 9; Bocken et al., 2022; Lorang et al., 2022; Bradley and Corsini, 2023). Reforms can include *command and control* measures – a sinking lid on overall packaging placed on the market, consumption reduction and reuse targets; bans and mandates to prohibit or require certain packaging types and practices, for example, single-use plastics bans or mandates to offer unpackaged products, accept customer BYO containers or offer reusable packaging options; and standards or essential requirements for reusable packaging systems to ensure best-practice and consistency – and *economic instruments* – deposit/return systems for single-use and reusable packaging; levies and taxes on single-use packaging, plastics and virgin materials, with funds redirected to financing reuse systems; tax relief or preferential procurement and investment policies for unpackaged or reusable packaging systems; and an enforceable financial obligation on producers to cover the recycling, clean-up and disposal costs of single-use packaging. These measures can be implemented in domestic laws and regulations, or internationally via treaties or other regional and multilateral instruments.

Policies to drive source reduction are distinct to policies to promote recycling and perform better if conceptualised and implemented separately (Gordon, 2021). For example, reduction and reuse targets should be segregated from recycling targets, while a proportion of the cost recovery for packaging waste management should be earmarked to cover the costs of reuse logistics. Incentives and targets should be individualised to the firm level, rather than collectivised across industry (Massarutto, 2014, 18). Although reducing plastics usage may be a key goal, measures should address single-use packaging of all material types, not only plastics (Dixon and Geßner, 2022). Furthermore, different instruments produce different outcomes and are likely best implemented as a package, rather than isolated measures (Walls and Palmer, 2001; Brouillat and Oltra, 2012; Global Plastics Policy Centre, 2023). These points highlight how the widespread approach of single-use plastics bans

could be improved by applying material agnostic bans and mandates instead, or combining bans with reuse targets, levies on alternative single-use items and subsidies on reusable packaging to direct industry towards reusable alternatives rather than material substitution.

Current examples of Government laws for packaging source reduction are sparse (Tencati et al., 2016, 42; Consumers Beyond Waste, 2022, 5), but appearing with greater frequency across jurisdictions (OECD, 2022c; Blumhardt, 2023). For example, Ireland's new Circular Economy and Miscellaneous Provisions Act 2022 creates the power for the Government to ban non-reusable packaging, while in Chile, supermarkets are mandated to offer beverages in reusable bottles (Blumhardt, 2023, 25, 30). France has set a legally binding consumption reduction target for single-use plastic packaging to decrease by 20% by 2025, and specified that 50% of this reduction must be met by reuse/refill systems, while Spain has a target to reduce single-use serviceware by 70% by 2030 (Blumhardt, 2023, 34). Several countries have set binding, timebound, sector-specific and product-specific reusable packaging targets, for example, Austria, France, Germany, Portugal, Romania and Sweden (Maillot, 2022). Chile and France have passed laws mandating hospitality to use reusable serviceware for dine-in customers, and Germany now requires any hospitality outlet offering takeaways to offer a reusable takeaway container option at a price equal to or cheaper than the disposable option (Blumhardt, 2023, 29). Spain has introduced a tax on non-reusable packaging, Austria and the United Kingdom have instituted a plastic packaging tax, while some jurisdictions apply levies on single-use items, such as coffee cups (Blumhardt, 2023, 37–38). In France, 2% of EPR contributions from packaging schemes are to be allocated to exploring opportunities for reusable packaging (Blumhardt, 2023, 38).

In future, measures could be applied more widely, in a more integrated, consistent fashion, both nationally and multilaterally, to avoid the fragmentation that characterises the current policy landscape for plastics generally (OECD, 2022a). Domestically, regulatory and economic instruments to drive source reduction could be rationalised with legislated EPR/PS packaging schemes, which aim to improve environmental outcomes for packaging by establishing financial and other obligations for packaging producers across packaging lifecycles (Rubio et al., 2019, 217). Globally, packaging EPR/PS schemes are not uncommon, providing a pre-existing framework to introduce source reduction measures alongside other instruments. However, as they have traditionally focused on recycling, with quite weak incentives and poor results for activities up the waste hierarchy, they may require reprioritisation to accommodate effective source reduction measures and avoid incentivising plastics reductions via lightweighting and material substitution (Massarutto, 2014; Watkins et al., 2017, 3; Rubio et al., 2019; Consumers Beyond Waste, 2021, 33–34; Copello et al., 2022, 7; Lorang et al., 2022; Upstream, 2022; OECD, 2022a, Box 6.4; Diggle et al., 2023, 13).

Multilateralism can also direct and coordinate implementation of source reduction. In the EU, the Single-Use Plastics Directive and the Packaging and Packaging Waste Directive, set binding expectations around source reduction for Member States, which is driving national-level legislative action. Internationally, the Global Plastics Treaty is a key opportunity to progress binding and harmonised packaging source reduction measures (Business Coalition for a Global Plastics Treaty, 2022; Dixon and Geßner, 2022; EMF, 2022; Scientists' Declaration on the Need for Governance of Plastics Throughout their Lifecycles, 2022; Global Plastics Policy Centre, 2023, 54).

Enabling measures

Transitioning to plastic-free packaging systems based on reduction and reuse is a systems-level change that demands a raft of practical enabling conditions to facilitate and accelerate industry uptake of systems, and to ensure resulting systems are efficient and effective in terms of social, economic and environmental outcomes. Key enabling conditions include globally coherent standards and definitions for best-practice system design and implementation; interoperable infrastructure and services for reverse logistics, including collections, washing, sorting, replenishment and redistribution; and collaborative mechanisms to maximise system and packaging standardisation within and across industry sectors (Global Plastics Policy Centre, 2023). Measures to foster these enabling conditions should accompany persuasive and legislative measures; otherwise, even the most highly motivated businesses may struggle to overcome current obstacles (such as the lack of necessary infrastructure to service unpackaged or reusable packaging systems), or may implement new models in an uncoordinated way, resulting in a fragmented landscape of poorly performing and/or siloed systems.

Enabling measures require shared industry or government-led oversight of the design and roll-out of unpackaged and reusable packaging systems, services and infrastructure, with a view to easing upfront capital expenditure and creating certainty and standardisation that de-risks new packaging models and avoids proliferation of vertically integrated systems. This could include official standard setting, such as the PR3-RESOLVE (n.d.) Reusable Packaging System Design Standards, or updates to food safety, public health and sanitation laws (many of which are silent on unpackaged or reusable packaging systems) to support clarity for workers, users and system operators (Global Plastics Policy Centre, 2023). Governments can also play the role of 'neutral facilitator' to broker multi-stakeholder collaboration to unlock system and packaging standardisation and ensure consumer participation and high rates of return (Mission Reuse, 2023, 9, 53). Targeted public procurement could be used to support standardised infrastructure and services. For example, Aarhus City municipality in Denmark tendered for an operator to deliver the reverse logistics for a citywide reusable serviceware pilot (TOMRA, 2023). Meanwhile, strategically ring-fenced funding streams can support capital expenditure for new packaging systems. For example, some Governments have established public funds that are earmarked for prevention and source reduction initiatives, for example, Sustainability Victoria in Australia, and the UK Government's fund for refills infrastructure (Consumers Beyond Waste, 2021, 46).

Conclusion

The tide has turned on plastic packaging and the pressure to find and implement alternatives that reduce plastic pollution and waste, while drawing down emissions, plastics production and toxicity, is rising. This review shares insights for policymakers and advocates of unpackaged and reusable packaging systems, alongside implications regarding necessary considerations for an effective global plastics treaty that supports a reduction in global plastics production. Academic research, civil society campaigns and progressive industry practice are constellating around the need for source reduction strategies to address plastic packaging, the single biggest consumer of plastics produced globally. These strategies focus on transforming products, business models and supply chains to prevent packaging entirely or accommodate reusable packaging systems. As such, they represent a radical step away from business-as-usual.

Incentivising industry to make this shift requires a suite of persuasive and enabling measures in the context of wider legislative reform that levels the playing field between reuse and single-use. Current approaches to stimulating packaging source reduction are overly reliant on persuasive, voluntary measures, in the absence of legislative reform. This essentially invites industry to invest in business models that go against their economic interests under current waste and packaging policy settings. Unsurprisingly, this has not happened, single-use plastic packaging usage continues to soar and the growth of reuse and refill businesses and advocacy 'is not currently happening fast enough to move the needle on the global scale of plastic pollution or climate change' (Moss et al., 2022, 10).

A reset of packaging law and policy at national, regional and international levels is urgently needed to align incentives and disincentives with voluntary/persuasive campaigns and with the initiatives that seek commercial uptake of plastic-free packaging systems based on reduction and reuse. In addition, enabling measures in the form of system oversight, and targeted procurement and investment should be factored in to any programme to promote unpackaged and reusable packaging systems, in order to remove obstacles associated with the lack of standards, infrastructure and services to deliver these systems. Such measures will also enable a coherent, interoperable packaging system that ensures social, environmental and economic efficiency. Overall, the Global Plastics Treaty negotiations present a key opportunity to accelerate progress, while aligning expected outcomes, measures and standards for plastic-free packaging systems around best-practice.

A key area worthy of further consideration is how to harmonise intentions with outcomes when seeking to incentivise unpackaged and reusable packaging systems. While these systems are still emerging areas of practice and scholarship, lessons can be learned from past experience attempting to improve the environmental performance of plastic packaging via downstream measures. The latter have not had a significant 'trickle up' effect on redesign or reduction; on many occasions, they have generated unintended negative environmental outcomes. Efforts to promote unpackaged and reusable packaging systems could avoid repeating this intention-outcome gap through more responsive monitoring and evaluation of applied measures against predetermined (timebound, measurable and binding) desired outcomes. Pre-empting possible unintended outcomes of these systems is also important, in order to ensure mitigating measures. In this respect, the calls to align systems around globally agreed best-practice standards to avoid environmental and economic inefficiency are relevant. Further research should also consider the right mix of measures to avoid a possible 'circular rebound effect' or Jevons paradox (Bradley and Corsini, 2023) and ensure that plastic-free packaging systems based on reduction and reuse remain tied to achieving an absolute reduction in global plastics production and pollution, greenhouse gas emissions and waste.

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