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# (Im)possibilities of "circular" production: Learning from corporate case studies of (un)sustainability

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ABSTRACT

This article discusses Cradle to Cradle (C2C) and circular economy designs including three key principles of C2C production as well as the so-called 9-R hierarchy of priorities in circular economy production. This article examines student assignments that apply these circular and C2C principles to the detergent brand Method, the refillable drinking bottle Dopper, and the packaging of Burger King. Product improvements identified by students include expanding transparency of the "invisible" aspects of production, such as the types of materials and energy used for packaging and transport, or the potential for take-back and repair. In the student analysis, it appears that the supposedly circular or C2C products have their shortcomings, especially when it comes to the first R of the 9-R hierarchy – Refuse or avoid making or buying new products. The larger lesson from these case studies is that the buzzword circularity might not be delivering on its promise of absolute decoupling of resource consumption from economic activity. Students are recommended to engage with tools, concepts, and approaches, such as critical thinking and degrowth strategies to provide insight into sustainable transformations for society.

## 1. Introduction

Academic and policy experts increasingly recognize that environmental problems, from climate change to biodiversity loss and pollution, are caused by social and economic factors, such as an increase in population, production, and consumption (Victor and Jackson 2015; Sullivan 2020). A closed-loop or circular production system is known as Cradle to Cradle (C2C) offers an opportunity to radically revise the current take-make-waste system of production (McDonough and Braungart 2010) and counter the built-in obsolescence (Bulow 1986). The aim of a circular system is, ideally, not just to increase the level of material and energy recovery but to eliminate the consumption of scarce materials (de Man and Friege, 2016). This aim is facilitated by the product service shift (PSS), which requires the re-organization of business through the transition from selling to leasing or pay-per-use schemes instead of ownership (Kopnina and Blewitt 2018; Sousa-Zomer et al., 2018).

C2C identifies three key principles of alternative production systems: (a) waste equals food; (b) use current solar income, and (c) celebrate diversity. *Waste equals food principle* emphasizes that unproductive waste should be eliminated. A fruit tree's "waste" provides nutrients for other species or soil when decomposed. *The use renewables principle* supports the sun and wind energy, which is, aside from installation, storage and transition, are infinite. *Celebrate diversity* refers to natural systems that support complex biodiverse communities, or ecosystems, where each member has developed a unique response to its surroundings that works in concert with other organisms. C2C products take nature's diversity as a prototype for tailoring designs to maximize their positive effects and enhance the local landscape (McDonough and Braungart 2010). Biomimicry designs, for example, imitate the complexity of natural forms, as well as their function and reciprocity with other natural elements (Stevens et al., 2020). This can be exemplified by bird nests. As Macdonald (2020) has described the chaffinch nest, "a thing of horsehair and moss, pale scabs of lichen and molted pigeon feathers" – something that is both fragile and functional as a home, but also fully biodegradable. Likewise, eco-houses are made of natural materials and with plants growing on walls, attracting insects and birds to share living space with humans, while contributing to the resilience of the building to seasonal cycles and various weather conditions.

These principles are translated into the C2C certification, which awards products an achievement distinction in categories Material

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Health, Material Reutilization, Renewable Energy, Water Stewardship, and Social Fairness. The products could achieve Basic, Bronze, Silver, Gold, or Platinum levels, with the lowest achievement level representing the product's overall mark (Cradle to Cradle Certified 2020).

Circular economy evaluations using the 9-R scale and C2C accreditation and certification are intended to inform producers' choices at various stages in the product's life. These evaluations also address the inputs (raw materials, energy, etc.) associated with all the production outputs, use, and disposal (Ünal and Shao 2019).

However, one of the challenges is that circular products need to be both locally produced with a minimum environmental footprint, and simultaneously to satisfy the demand of global consumers. Isenhour (2010) notes that individual consumers might be either uninformed or unmotivated, or tricked by the supposedly "green" marketing that stimulates the consumption of new products, causing a rebound effect. Also, as an individual's sphere of influence on the process of production is too small, and governments and corporations make the bulk of decisions, consumer responsibility can be seen as a strategy of corporate and political power holders to "defend their ability to resist the regulation of resource-intensive, polluting or socially damaging products" (Isenhour 2010:456). A distinction between ideal, realistic, and subverted circular practice is helpful (Kirchherr et al., 2017).

This article discusses how Bachelor business students apply their understanding of circular frameworks to corporate case studies analyzing supposedly circular or C2C products. In the sections below, C2C principles and the 9-R strategy are elaborated on, then the case studies, strengthening students' critical thinking about the circular economy, are examined. Based on the analysis of these case studies, recommendations for foregrounding degrowth in business education are made.

### 1.1. C2C principles and 9-R strategy for circular economy

McDonough and Braungart (2010) observe that conventional production systems, e.g. production of washing machines or simple electronic goods, make products of mixed materials difficult to separate and recycle; consequently, they argue these forms of production systems create so-called "monstrous hybrids". By contrast, C2C product technical cycles are supposed to be easy to disassemble to enable refurbishment, reparation, or retention to meet another need (Iacovidou et al., 2017).

This example ties in with various levels of the 9-R hierarchy of circular production, developed by the Dutch Council for the Environment and Infrastructure (RLI 2015) and revised in consequent publications (e.g. Kirchherr et al., 2017; Potting et al., 2017). The first R of Refuse (R-1) means "doing without", thus stimulating degrowth. The objectives of degrowth "are to meet basic human needs and ensure a high quality of life, while reducing the ecological impact of the global economy to a sustainable level, equitably distributed between nations" (O'Neill 2012:225). Hickel (2020: 205) describes degrowth as "an economy that's organized around human flourishing and ecological stability, rather than around the constant accumulation of capital", an economy that does not need growth in the first place. O'Neill (2012) proposes a measure of degrowth transition through the none-GDP-related quality of life as the true measures of progress, such as social welfare indicators. Degrowth promises to enable the voluntary transition towards a just, participatory, and ecologically sustainable society through dropping GDP as a measure of progress (O'Neill 2012). Perhaps the trickiest, the vaguest, but also potentially most transformative R of the scale is Rethink, which can mean redefine "growth", but also merely optimize the design. Reduce is akin to conventional eco-efficiency ranks higher than Re-use. In the C2C framework, eco-efficiency only extends a wasteful system of production. Recycling normally leads to mostly "downcycling", resulting in resource loss (McDonough and Braungart 2010). However, reduction rather than the complete elimination of harm might be the most realistic and achievable for material products.

Infinite reuse implies that no new products need to be made, thus closely related to Refuse (to make or buy), essential to an overall degrowth strategy. Infinite Reuse can be said the best promise of absolute decoupling, satisfying the ultimate goal of the closed-loop systems to decouple the economy from environmental pressures (Ghisellini et al., 2016).

Reuse is facilitated by Repair, countering the throw-away economy of cheap consumer goods, or built-in obsolescence (Bulow 1986). Helpfully, "Repair isn't a partisan issue", Gordon-Byrne, executive director of the Repair Association (in The Economist, 2017:59), as "a liberal sees the livelihood of repair shops endangered by big corporations" and for a conservative, "not being able to repair his tractor" amounts to an attack on the "very idea of private property" (The Economist, 2017a:59). Refurbishment (R-5) refers to restoring defective products to their original condition. Remanufacture (R-6) refers to developing a new product with parts of old products (Potting et al., 2017). Repurposing (R-7) implies reusing products for other purposes. Some materials are not suited for repurposing, for example, making clothes from plastic bottles as plastic is not made to be recycled (it degrades and omits toxic materials in the process) (McDonough and Braungart 2010). Recycling (R-8) is the most labor- and energy-intensive of the options to "reduce, reuse or recycle" (Ghisellini et al., 2016).

Recovering (R-9) of materials and burning them to produce energy is positioned as the lowest option in the hierarchy. There is a big difference between energy derived from, for example, sun, and biofuels, derived from burning remains of timber industry's production. While recovery of valuable materials such as metals in electronics or mechanical industries has significant sustainability gains, recovery is particularly difficult if not impossible in the food industry and packaging (Aarnio and Hämäläinen 2008). Petrochemical waste used for making conventional packaging is typically cheap, yet responsible for massive micro-plastic pollution (Schneider 2008), thus another challenge is making sustainable alternatives affordable.

#### 1.1.1. The danger of subversion

The circular economy is touted as the "new engine of economic growth" by Ellen MacArthur Foundation (EMF 2013: 64), inspiring optimism but also opening the door for greenwashing. McDonough & Braungart's book, The Upcycle (2013), illustrates this optimism in suggesting that production of the 'right' products can add value and have a net positive effect on ecosystems.

Some C2C- certified or the 'good practice' companies on the list of Ellen MacArthur Foundation (EMF is the largest promoter of circular economy) corporate case studies (http://www.ellenmacarthurfoundation.org/case_studies/), include Coca-Cola, with their "monstrous hybrid" plant bottle (combining and organic and non-organic materials) and other companies, which stimulate downcycling, rather than attempting to halt production through infinite reuse (Kopnina 2019, 2021).

de Man and Friege (2016) inquire whether the politically attractive message of a circular economy that promises to enable continued economic growth while radically reducing the level of waste production is scientifically correct. The authors note fundamental problems:

1. "… in reality, waste is rarely 'food'. Creating endless material cycles without continuously adding energy would be counter to the Second Law of Thermodynamics …
2. The assumption that natural nutrients can be fed into the ecosphere without any problems regardless of their quantity is not correct. There are scale problems …
3. The production of beneficial consumer products almost always resulted in the generation of industrial wastes […], necessitating treatment and disposal of unexpected waste flows (e.g. petroleum waste, nano-particles)" (Man and Friege 2016:4,5,6).

What exacerbates these issues is the fact that there are almost 8 billion aspiring consumers worldwide and large-scale solutions to unsustainable production are needed. Demographic changes are rarely

discussed in circularity literature. In addressing environmental problems, the estimates made by the World Health Organization (WHO) and the Intergovernmental Panel on Climate Change (IPCC) "failed to take into account vulnerabilities caused by aging, migration, and population growth" (The Economist, 2015a:69). While some countries have gone through demographic transition (lower mortality to lower fertility), the middle classes are still expanding, also in developing countries, with people living longer, and migrating from low income to high income and consumption countries (The Economist, 2015a). The UN predicted that Africa's population would increase to about 2.3 billion in 2100, with Latin American fertility also on the rise (The Economist, 2015b, 2019). The increased global population further drives demand for natural resources, especially if the products are to remain affordable for poor people (Lidicker 2020; Washington and Maloney 2020). For example, the production of "circular packaging" might be impossible since the use of petrochemical waste currently used is cheap, while alternative packaging is more expensive. As Unilever expressed it at the time of the corona crises:

The Covid-19 pandemic has brought new challenges in tackling plastic pollution. These include the availability of certain materials, the inability to test new materials with our suppliers and in our factories, and the closure of sorting and recycling centers in some markets. The decreasing price of oil also makes it harder for recycled plastic to compete against lower-cost virgin materials too. Yet we remain as committed as ever to shifting to a circular economy for plastics (Unilever 2021).

Demographic changes imply that a massive scale of change is needed in politics as well as a worldwide corporate strategy, including critical thinking about the circular economy, particularly in education. Critical thinking, in this instance, refers to a purposeful and reflective activity that leads to interpretation, analysis, evaluation and inference, and reflections on which the judgment is based (Fong et al., 2017). UNESCO (2017) include critical thinking as a key competency in sustainability education as it equips students with the ability to question norms, practices, and opinions; to reflect on own one's values, perceptions, and actions; and to take a position in the sustainability discourse. Given the relative complexity of C2C and circular economy-related concepts and impacts, including planned and unplanned consequences of mitigation strategies across multiple scales, instilling critical thinking approaches appears a worthwhile cause in circular economy education.

### *1.1.2. Circular economy in education*

Circular economy education programs have grown in popularity in recent years, and generally, these programs tend to sit within the sustainable business, enterprise, and/or innovation-themed courses. While teaching for sustainability can be accomplished through this alternative education that emphasizes planetary ethics and degrowth, this is not present in most programs surveyed for this research. The specific concern is that the plethora of issues that fall under social and economic sustainability taught under the banner of sustainability takes away the educational focus on the environment (Kopnina 2012). In 1975, following the guidelines for sustainability education, developed at the 1972 UN Conference on the Human Environment and responding to the need to address the environmental issues, the Belgrade charter (UNESCOUNEP, 1976) was produced. It stated:

> "The goal of environmental education is to develop a world population that is aware of, and concerned about, the environment and its associated problems, and which has the knowledge, skills, attitudes, motivations, and commitment to work individually and collectively toward solutions of current problems and the prevention of new ones".

Globally, there are initiatives under the banner of "sustainability" aplenty, from topics including human welfare, health, human rights, gender equality, and circular economy, especially under the banner of the new Green Deal presently embraced by the European Union (EU). There are plenty of similar programs run abroad. In the late 2000s, the University of Leeds established one of the UK's first Masters' programs in Sustainability and Business (https://courses.leeds.ac.uk/g721/sustainability-and-business-msc). This program exposes students to a variety of key concepts in sustainability and business, and both circular economy and degrowth concepts take a central part of the curriculum. The University of Oxford has launched an MSc in Sustainability, Enterprise and the Environment, which teaches 'sustainable development through the lenses of enterprise, finance, and economics (https://www.ox.ac.uk/admissions/graduate/courses/msc-sustainability-enterprise-environment).

There is an emerging trend of programs incorporating elements of a circular economy or sustainable business into the curriculum, such as University of Vermont's MBA in Sustainable Innovation (https://www.uvm.edu/business/simba_sustainable_innovation_mba) the Master of Environment and Business at the University of Waterloo in Canada (https://uwaterloo.ca/school-environment-enterprise-development/graduate/master-environment-and-business) and Universiti Teknologi Malaysia's MSc in Sustainable Systems (https://mjiit.utm.my/master-of-sustainable-systems).

In the Netherlands, several institutions are offering Master's level degrees on these themes, such as the Business and Sustainability program run by Erasmus University in Rotterdam,[1] the Sustainable Business and Innovation program at the University of Utrecht ,[2] and a Sustainable Finance program by Maastricht University.[3] Erasmus University in Rotterdam offers Masters of Business and Sustainability..[4]

The University of Utrecht runs a [5] Sustainable Business and Innovation program. Maastricht University runs a Sustainable Finance program.[6]

A typical formulation of these schools' objectives often aligns with the mission statements of their sponsors as some programs are partially (overtly or not) supported by corporate funding. The program described below at The Hague University of Applied Sciences (HHS), also involves close cooperation with the corporate sector, whereas students consider it a success to be "headhunted" by employees, or more typically get jobs via their internships (Kopnina 2019). As with all programs that have "green", "sustainable", responsible", ESD, EE, ESDG, EES in their title, the content of the program may vary from paying lip-service to corporate sponsors, thus "sustaining the unsustainability" (Blühdorn 2017) to more radical transformative efforts (Kopnina 2020). How much "beyond state of the art" promotes profit as the ultimate bottom line and how can students be taught to look beyond the companies' mission and vision statements?

Distinguishing which existing (business) programs promote profit as the ultimate bottom line, and what programs promote critical thinking, is one of the challenges of education for the circular economy. The student presentations of the circular economy case study described below provide an example of the latter.

## 2. The case study: student presentations of circular economy

The HHS has Climate Management to Facility Management faculties that offer courses, which fully or partially concentrate on circularity. There is also a Mission Zero research collective, including the Circular Business group, which involves students and faculty in corporate

[1] https://www.eur.nl/en/master/global-business-sustainability.
[2] https://www.uu.nl/masters/en/sustainable-business-and-innovation.
[3] https://www.maastrichtuniversity.nl/education/master/master-international-business-track-sustainable-finance.
[4] https://www.eur.nl/en/master/global-business-sustainability.
[5] https://www.uu.nl/masters/en/sustainable-business-and-innovation.
[6] https://www.maastrichtuniversity.nl/education/master/master-international-business-track-sustainable-finance.

projects. However, some of the corporate partners that Mission Zero engages with, such as "circular fashion" companies (Poldner 2020), claim circular ambitions without considering Refuse (https://www.thehagueuniversity.com/research/centre-of-expertise/details/centre-of-expertise-mission-zero).

One of the programs of the International Business (IB) department of HHS offers the elective minor Sustainable Business that offers a critical thinking course that, among other subjects, presents theory and practice of circularity. In this minor, different theoretical frameworks, ethical dilemmas, as well as the practice of environmental and corporate governance are discussed, linking the subjects of business, politics, environmental ethics, sustainability, and economic development. The course considers ecologically benign models of production, and particularly degrowth economy, steady-state-economy, C2C, and circular economy.

The case studies described by groups of students reported below involve randomly selected (the first one in order of presentations in each year: 2018, 2019, and 2020) presentations. These presentations were part of one of the five modules of the minor, called Politics, Business, and Environment. For theoretical background, the students were assigned some of the readings mentioned in the introduction of this article as well as encouraged to supply their references as background for interactive debates (on the subject of decoupling) and role-play (pretending to be CEO's of Shell interacting with activist shareholders).

Assignment specifications included examination of supposedly circular or C2C-certified products. The students could evaluate Ellen MacArthur Foundation's case studies using the circularity evaluation tool: http://circulareconomytoolkit.org/Assessmenttool.html or C2C case studies https://www.c2ccertified.org/resources/collection-page/case-studies using C2C certification/accreditation http://www.c2ccertified.org/and http://www.mbdc.com/cradle-to-cradle/cradle-to-cradle-certified-program/. Based on these certification categories, the students needed to discern cases of greenwashing, an aspiring/promising, or a best-case study.

One of the groups took the case of *Method,* a cleaning material company (https://methodhome.com/). The second group considered the *Dopper*, refillable drinking bottle (https://dopper.com). The third group looked into the "circular packaging" of *Burger King* (https://www.bk.com/corp-respon). After the presentations, the students were engaged in an in-class discussion about the larger implications of (un) sustainable production.

### 2.1. Method

The students discussed Method's branding, history, product design and processes that avoid material waste, and cooperation with suppliers to ensure the highest quality standards. Founded in 2000 in San Francisco, and present in more than 40,000 retail worldwide locations, Method calls itself "the pioneer of premium planet-friendly and design-driven home, fabric and personal care products". As their website states, the products are formulated with 75% of Method's naturally derived, biodegradable materials. "Method cleaners put the hurt on dirt without harming people, creatures or the planet" with their "powerful, planet-friendly cleaning products" that "handle big messes beautifully" (https://methodhome.com/). Method Products PBC and the Cradle to Cradle Products Innovation Institute awarded select products C2C CertifiedTM GOLD. The certified products include household cleaners, laundry care, and personal care (https://methodhome.com/press/leading-cleaning-products-company-method-commits-majority-product-line up-cradle-cradle-product-certification/). The students have summarized why they thought Method products were C2C in Fig. 1 below.

The students also noticed that the product was not fully C2C. It was not clear from the company website, students have reflected, what type of renewable energy– wind, solar, biofuels, or thermal - and what proportion (energy mix) was used. While 75% of some of the Method's products are naturally derived, it is not clear how the other 25% are composed and what are the carbon emissions produced in the process. Presenting group has noted that Method packaging does not reach the higher R's in the 9-R hierarchy, and while parts of packaging may be reusable, most are at best recyclable.

Discussing solutions, the students have suggested that Method needs to rely on wind and solar energy. As one of the students indicated, while biofuel is sometimes presented as "renewable energy", it destroys biomass. The students also noted the need to utilize either biodegradable or reusable packaging, for example by encouraging consumers to bring back and refill the empty containers.

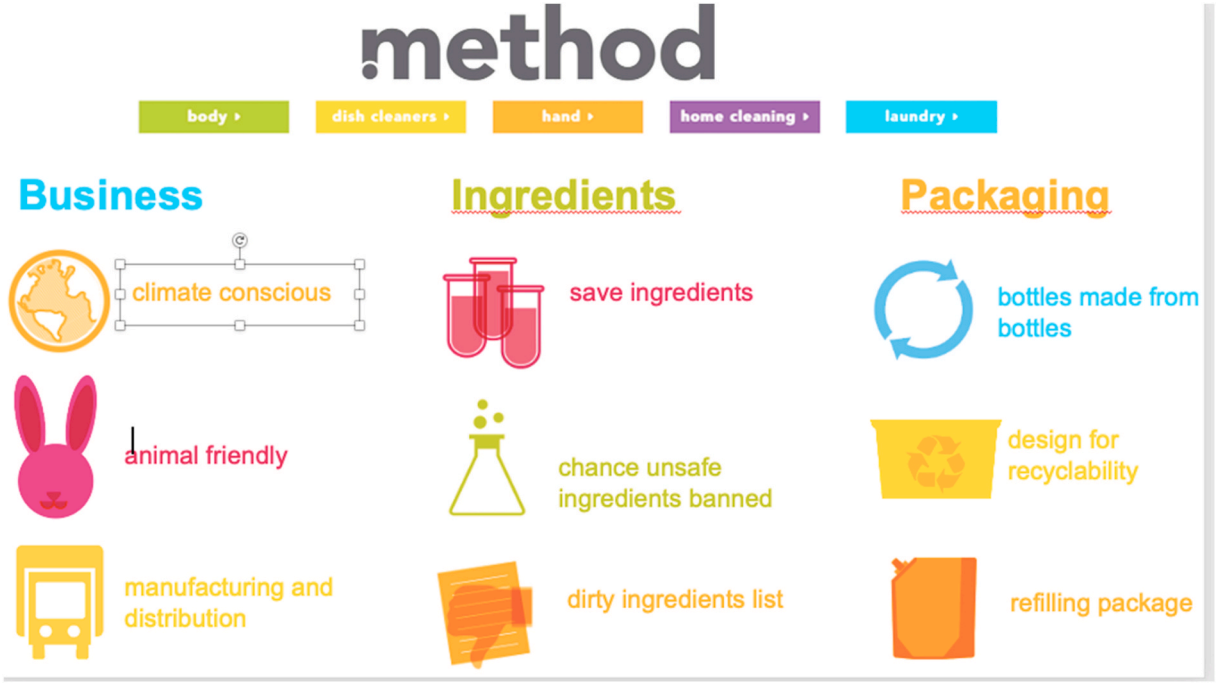


**Fig. 1.** *Method: why C2C. *[Source: student assignment, reproduced with original grammar/spelling].

### 2.2. The Dopper

The student group presenting the refillable drinking bottles Dopper has reported that according to the company's website, "Dopper is on a mission to empower people to choose reusable over single-use water bottles to protect our world's water sources". The Dopper Original is a certified Bronze C2C product, following goals of the Dopper are to reduce single-use plastic in all components and "increase access to safe drinking water around the world".

Based on Dopper's website, the students noted that the thermoplastics of which the bottle are advertised as being made to be 100% recyclable, with the bottle allegedly produced in a "climate-neutral manner, with responsible use of water and energy". The top, middle, and bottom can be unscrewed. As far as material health C2C evaluation is concerned, the students noted that it was claimed that "no toxic or prohibited substances (such as antimony or Bisphenol A) are used" (Preserve 2020) and that the thermoplastics were 100% recyclable. As for social responsibility, the students noted that through the Dopper Foundation a contribution is made to drinking water projects worldwide. Dopper states that through donating 5% of its net turnover to the Dopper Foundation, thousands of people in Nepal have access to clean water, thus contributing to social welfare (https://dopper.com/blog/everything-you-didnt-know-about-dopper-in-nepal). The students also noticed other limitations (Fig. 2).

The students noted that the company does not disclose full details of its production process, it is not clear what type of materials are used for each component of a plastic bottle, or what type of energy and in which proportion is used. Also, Dopper stimulates the consumption of new bottles. A customer is quoted on the Dopper website: 'The Dopper is our handiest bottle! We have five of them' (Dopper 2015). The students also found out that the colored Dopper base and cap are made from #5 Polypropylene (PP), the white shiny neck is made from #7 Acrylonitrile Butadiene Styrene (ABS) (Preserve), and the ridges around the rim are made from Thermoplastic Elastomers (TPE) (How it's Made 2014). The company does not specify what percentage of the bottles are made from recycled PP or of parts of the old Doppers. Although Dopper says that it is "produced with responsible water and energy use", it only received a Bronze for "Water Stewardship" (Cradle to Cradle Certified, 2020).

The students also noted that while the old Doppers can be returned to special plastic recycling points, it was not clear where these points are located. While the website claims that Dopper's components are "made of 100% recyclable plastic" it is far from obvious that this plastic is collected and recycled. One student demonstrated her Dopper bottle in class, with part of its lid broken off, reflecting that she does not know where to send her broken bottle for repair to substitute this part. As the Economist (2017:58) reported: "Firms say that restricting repairs, either by individual consumers or businesses, helps to protect their intellectual property". Thus, the potential for take-back and repair of Dopper's drinking bottles (product to service shift) seems consciously restricted.

Student recommendations for improvement included consideration of these actions:

- Using non-colored plastic because harms the environment.
- The products need to have 100% A, B, C ratings and contain no X-assessed materials.
- A clear source of renewable energy should be indicated.

### 2.3. Burger King

The student group discussing Burger King praised the company for introducing vegetarian burgers, as meat consumption has been linked to many problems, from climate change (due to methane emissions of cattle) to zoonotic diseases such as Covid-19 (Aguirre et al., 2020), as well as animal suffering. After discussing the advantages of burgers with meat substitutes, the students presented the new initiative of Burger King to develop "circular packaging". The students quoted a blog by Sabri (2020):

Burger King has been leading the charge on foodservice sustainability and is now taking a step into the circular economy. The fast-food chain announced earlier this month that it will begin offering reusable packaging, starting next year. A trial will begin at select restaurants in New York, Portland, and Tokyo for sandwiches and drinks. Making this move possible is Burger King's partnership with TerraCycle's Loop initiative, which facilitates corporate transitions to reusable packaging. The trial is part of Burger King's goal to source all packaging from renewable, recyclable, or certified sources by 2025. And this step forward

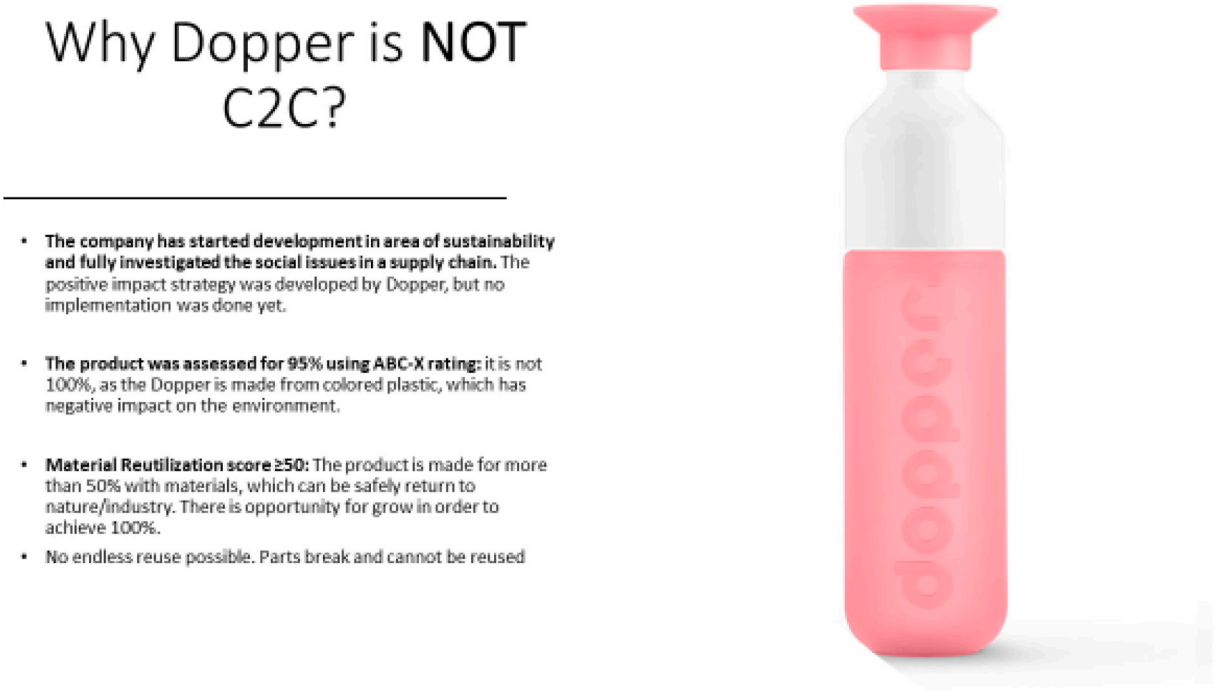


**Fig. 2.** Why is Dopper not C2C?.

couldn't have come at a better time, as many restaurants have resorted to single-use options during the coronavirus pandemic.

TerraCycle's Loop initiative (https://www.terracycle.com/en-US/pages/closed-loop-solutions) announced on its website that it works closely with corporate partners to develop closed-loop solutions for various waste materials. "These solutions range from promotional applications, where we can manufacture premium products to large scale deployments, to fundamental closed-loop operational applications". The students noted that the upper R's of the 9-R circularity scale can be reached by making wrappers for burgers in such a way that they can be returned by consumers, cleaned, and reused multiple if not infinite times.

However, it was not clear to the presenting students examining TerraCycle's Loop what such wrappers could be composed of. As one student noted in the presentation: "probably something in a technical cycle, with hard plastic that should not be released back in the environment". Another student reflected that it could also be biodegradable packaging, but that would necessitate "one-time use, and to make this packaging, probably soya or other organic material will be used and wasted". If such organic material could be afterward used for "making compost for growing grass for the cows that later serve as burgers", the same student reflected, "|There could be at least partial circularity, just for one cycle". However, none of the detail of the (intended) cooperation between Burger King and TerraCycle's Loop indicated such solutions. The students noted that while preparing their group presentation, the information on the website of Burger King about this initiative had disappeared, and the details of "circular packaging" were no longer linked to Burger King. Reflecting on this and Ellen MacArthur's website's cases, the students noted that companies promise to change or transition and then, as one student expressed it, "get stuck in their business-as-usual way of doing things", or simply not follow up with their ambitions.

## 3. Discussion

One of the larger issues revealed by student presentations of corporate engagement with circularity is greenwashing. In Method, the *waste equals food principle* of C2C only applies to the packaging and not the food itself. "Organic packaging" can also present a problem, as it can only be used once before being composted, and the biomass is likely to require monoculture plantations, competing with agriculture and remaining wild nature areas (Kopnina 2017). If that "circular" packaging is to be made durable, as some initiatives illustrate (Unilever 2021), the scale of production (almost a billion consumers) still needs to be considered.

In the case of consumables, such as food items, circularity is impossible without considering what happens to waste products that end up in the toilet. Thus, the optimism about absolute decoupling of natural resource consumption from economic growth (Washington and Maloney 2020), let alone upcycling is rarely warranted, especially in the case of consumables.

In the case of Dopper, parts constitute a "monstrous hybrid" and can break off, with repair impossible, necessitating new purchases. This links to the rebound effect ultimately driving more consumption (Isenhour's 2010). The Dopper embodies the current emphasis on lifestyle choices within sustainability discourses and does not address issues of corporate and political regulation that could potentially ban the sale of PET bottles entirely.

Some of the companies improve one small part of their operation, without the needed overhaul of the *entire* supply chain, mode of operation, and the radical change in product materials (Kopnina 2019). Thus, optimistic 'simple and easy' approaches need to be treated with caution (Kirchherr et al., 2017; Kopnina and Blewitt 2018), particularly in light of a growing body of evidence that shows circularity approaches can obfuscate rather than bring clarity to the challenge of sustainability (Corvellec et al., 2021). It is crucial, therefore, to make a distinction between ideal and subverted practice, when circular economy implementation results in superficial changes at best, with the buzzword circularity not delivering on its promise of a fundamental change (Kirchherr et al., 2017; Corvellec et al., 2021).

A useful analytical tool for students to test the extent to which a company is genuinely innovating, greenwashing, or merely meeting minimum compliance is Sustainability Orientated Innovation (SOI). SOI posits innovation along a spectrum of impact: from Operational Optimization (e.g. meeting regulatory requirements), Organizational Transformation (e.g. leading to internal change) through to Systems Building (e.g. driving institutional change in society). Adams et al. (2016) identify some generic and more specific examples that fit these representations across the SOI spectrum. For Operational Optimization, examples include companies meeting the minimum environmental pollution as required by legal frameworks. In terms of Organizational Transformation, examples include the development of an organizational culture towards sustainability, such as incentives and reward systems. In Systems Building, there are fewer examples to draw from but a standout one is Unilever's Sustainable Living Plan, which works with governments and NGOs on broader system transformation to tackle food, energy, and health issues. In this way, Unilever is aiming to bring about wider transformative in society by engaging beyond their core stakeholders to drive institutional change (Unilever, 2021a,b). Following this line of thought, it could be argued that degrowth represents the potential to shift a city, region, sector, or an entire economy to a more sustainable path, which exemplifies a Systems Building approach (see Fig. 3).

In the student assignments above, it appears that even supposedly C2C or circular products have their shortcomings, especially if Refuse or infinite Reuse and consumer behavior are taken into account. Continuing to use a pen, manufactured over a hundred years ago, rather than buying a new supposedly "circular" pen, could be a good example of consumer behavior change supporting (almost) infinite re-use. To make money, companies could be leasing excellent durable cooking pens to those who have not inherited them from one's grandparents with the possibility of lifelong ownership. The larger lesson from a thorough examination of Method, the Dopper, and "circular packaging" is that neither of these products promotes degrowth, and their strategy of green marketing might lead to the rebound effect. Accordingly, this example aligns closest with SOI's operational optimization than organizational transformation or Systems Building.

While Method contains biodegradable materials, it is very far from the ideal of biomimicry (Stevens et al., 2020). Also, biomimicry can create problems (Potts et al., 2018) – for example, replacing bees with autonomous robots results in detrimental impacts to biodiversity but also neglect the values associated with natural pollinators, such as their intrinsic worth (Buchmann-Duck and Beazley 2020).

As a result of these challenges, many companies claiming to contribute to the circular economy merely scratch the surface. From an SOI perspective, companies may employ an organization transformative or even System Building rhetoric, but in reality, is far closer to operational optimization in their innovation. Buchmann-Duck and Beazley (2020) emphasize that while the circular economy holds many benefits for society, the practice's evasion of scrutiny has prevented it from manifesting in a comprehensive solution to environmental issues. The cases above illustrate the never-ending cycle of production (with products made of either from virgin or with downcycled materials) and consumption. Daly (1991, p. 184) notes that real production and consumption are in *no way circular*. The growth economy sees outputs returned as fresh inputs (ibid. p. 197). As the examples above showed, neither product is directed at minimizing consumption.

While the examples above show shortcomings of production processes that claim to be effective, rather than efficient, it is also possible to conceive of better examples that take the core principles of circularity into account. These can be found in pre-industrial production systems, but also innovative products and systems. To avoid unwarranted optimism in techno-fixes and greenwashing, these innovations need to be

| *Approach* | **1. Operational Optimization "Eco-Efficiency"** | **2. Organizational Transformation "New Market Transformation"** | **3. Systems Building "Societal Change"** |
|---|---|---|---|
| *Tag line* | "Doing the same things but better" | "Doing good by doing new things" | "Doing good by doing new things with others" |
| *Innovation Objective* | Compliance, efficiency | Novel products, services, or business models | Novel products, services, or business models that are impossible to achieve alone |
| *Innovation Outcome* | Reduces harm | Creates shared value | Creates a net positive impact |
| *Innovation's Relationship to the Company* | Incremental improvements to business as usual | A fundamental shift in company purpose | Extends beyond the firm to drive institutional change |

**Fig. 3.** Three dimensions of Sustainability Orientated Innovation Source: Adapted from Adams et al. (2016).

critically examined and if necessary attuned. Other solutions are already present in the form of low-hanging fruits as most corporate strategies embrace win-win situations: for example, saving energy by companies directly translates into saving money. The crucial question here, from the C2C or circular point of view, is whether the electricity is still generated by fossil fuels and thus prolongs the unsustainable system. Solutions identified by students in the cases discussed above include expanding transparency of the "invisible" aspects of product production or distribution and storage process, such as packaging, examination of what types of renewable energy are used, and the possibility of avoiding the production of new products.

To avoid the rebound effect, several practical recommendations can be made (Victor and Jackson 2015; Ünal and Shao 2019). de Man and Friege (2016) recommend a policy that should focus on instruments that can effectively influence the market.

- Economic incentives like the establishment of extended warranty periods would contribute to enhancing the longevity of products ('design for repair').
- Rules for the design of specific products […] would foster recovery ('design for recycling').
- More transparency about the materials used, especially in the case of complex long-living goods (buildings, electric devices, etc.), is necessary to facilitate methodical deconstruction.

While the dominant ideology of growth has constructed a global society predicated upon fitting the environment into the economy, the circular economy could provide an opportunity to challenge this deep-seated fallacy (Buchmann-Duck and Beazley 2020). Yet, to do so, the circular economy needs to explicitly incorporate and prioritize key aspects that are currently discounted, such as the intrinsic value of biodiversity (Taylor et al., 2020), and acknowledge its critical limitations (Buchmann-Duck and Beazley 2020).

In terms of social fairness, recent conceptualizations of degrowth have emphasized the need to analyze the impacts of degrowth strategies in a more holistic way to avoid reinforcing existing social and environmental injustices experienced in the Global South (Dengler and Seebacher 2019). An example is a stance taken by several retailers and environmental NGOs to boycott – or Refuse (R-1) – palm oil due to concerns over deforestation in palm oil-producing regions (Meijaard and Sheil 2019). However, while this strategy may aim to 'green' the supply chain of these particular products and companies, such a strategy may inadvertently marginalize a significant number of poor and vulnerable communities who have become reliant on the income derived from palm oil production. A holistic and fair degrowth strategy would, thus, aim to address the socio-economic needs of the affected communities – e.g. in this instance via an alternative cropping program and/or alternative income-generating activities for palm oil cultivating communities – to counterbalance the detrimental social impacts of a blanket palm oil boycott. Such a strategy requires collaboration across a range of stakeholders, including the organizations that use palm oil in their products (e.g. manufacturers, retailers) through to communities and government agencies in palm oil-producing countries. However, one can also argue that when biodiverse habitats are destroyed, the long-term prosperity of the most vulnerable communities is fundamentally challenged. While commercial enterprises and right-wing politicians might argue that good business is good for poor people, arguing that rising tide lifts all boats, most of the profit gets stuck on top due to corruption, and the poor and the environment pay the highest price. While Dopper may be raising awareness about the impact of single-use plastic, the company is not highlighting the essential links between production and environmental degradation, such as the root causes of the polluted water in Nepal (e.g. industrial contamination). Learning from this, students can ask more challenging questions about capitalism (or industrial socialism), development, and neoliberalism.

In education, a sustainable business curriculum should consider limitations to the circular economy and instead focus on degrowth (O'Neill 2012) as a more challenging but potentially transformative part of corporate strategy. Reflections and analysis of the extent to which social and technological innovations lead to meaningful change or simply reinforce the status quo – via frameworks such as SOI – also have a place in this emerging educational strategy.

This educational strategy can be further strengthened by critical pedagogy (Fromm 1963; Freire 1981) and ecopedagogy (Kahn 2008)

that highlights the importance of education based on ecological values. Kahn (2008) has noted that the issue of social justice and economic inequality is often placed to the fore of educational agendas, while ecological injustice against nonhuman species is hardly addressed. Kahn criticizes autocratic apparatus that produces slogans like “sustainable development”, based on Fromm’s and Freire’s work in the context of modern capitalist society. The inability to distinguish which types of sustainability education can contribute to developing informed, caring, motivated and critically discerning students able to address environmental and social challenges could also be regarded as a root cause of the shallow progress in sustainability education. One of the persistent challenges and also ways forward is the need to recognize and act upon the limited availability of natural resources.

There might be the need to turn back to The Limits to Growth report (Meadows et al., 1972), rethinking growth in population and production, and the Belgrade charter (UNESCOUNEP, 1976), rather than rushing forward with yet another optimistic "Green deal". One must hope it is not just lip service like many other popular buzzwords, promising win-win solutions to sustainability crises, including the circular economy.

## 4. Conclusion

In the case studies discussed above, absolute decoupling, upcycling, and infinite reuse remain ideals. Far from adhering to Refuse or Reuse principles through product-service shift PSS, most companies continue production using virgin or recycled (downcycled) resources. The greatest challenge for manufacturers is finding a way to make money while supporting environmentally-conscious consumers. One of the greatest challenges for education, in this regard, is to educate critically discerning citizens in the spirit of the Belgrade charter. Future research in education for the circular economy includes developing student ability to distinguish between ideal and realistic case studies, with a specific understanding of the necessity to address the first R of the 9R hierarchy in production and consumption. Tools, concepts, and approaches to assist students in this endeavor include critical thinking, degrowth strategies, and frameworks that provide insight on the transformative nature of technological innovation, such as SOI. Moreover, there is a need for studies that examine the flows of knowledge and influence between educational institutions and organizational practice within the context of the circular economy. Studies could examine how graduates affect their places of work post-study and to what extent the learning tools, concepts, and case studies exposed to students at university are instructive for contemporary challenges in organizations. Finally, this knowledge domain would benefit from a wider comparison across multiple institutions teaching circular economy. Reflecting the limitations of this particular research paper, which analyzed student case studies from only one learning institution, studies examining a cross-section of institutional learning programs and curriculum across different geographical settings would be beneficial to the field.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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