

DRAFT Kopnina, H. (2018) 'Teaching circular economy: Overcoming the challenge of green-washing'. *Handbook of Engaged Sustainability: Contemporary Trends and Future Prospects*. Ed. by S. K. Dhiman and Marques, J. Dordrecht: Springer. Pp. 1-25.

## **Teaching circular economy: Overcoming the challenge of green-washing**

Helen Kopnina

Dr. Kopnina, Helen (Ph.D. Cambridge University, 2002) is currently employed both at the Leiden University and at The Hague University of Applied Sciences (HHS) in The Netherlands. At Leiden Institute of Cultural Anthropology and Development Sociology, she lectures in anthropology and development. At the HHS, she is a coordinator and lecturer of Sustainable Business program and a researcher in the fields of environmental education and environmental social sciences. Kopnina is the author of over eighty peer-reviewed articles and (co)author and (co)editor of twelve books.

E-mail: [h.kopnina@hhs.nl](mailto:h.kopnina@hhs.nl)

### **Abstract:**

This chapter will introduce the circular economy (CE) and Cradle to Cradle (C2C) models of sustainable production. It will reflect on the key blockages to a meaningful sustainable production and how these could be overcome, particularly in the context of business education. The case study of the course for bachelor's students within International Business Management Studies (IBMS), and at University College in The Netherlands will be discussed. These case studies will illustrate the opportunities as well as potential pitfalls of the closed loop production models. The results of case studies' analysis show that there was a mismatch between expectations of the sponsor companies and those of students on the one hand and a mismatch between theory and practice on the other hand. Helpful directions for future research and teaching practice are outlined.

**Keywords:** circular economy; closed-loop production; cradle to cradle; environmental education; sustainable consumption; sustainable production

**Introduction: The concept of sustainability in linear and circular systems**

The mainstream sustainability models tend to focus on minimizing environmental damage, with negative effects merely delayed but not eliminated by eco-efficient technologies (McDonough and Braungart 2002). John Foster (2012) has noted that consumer-capitalist thinking has largely allowed unsustainability to persist. In the words of Blüdhorn (2007) symbolic politics of sustainability only ‘sustains the unsustainable’. Despite international conferences and talks, any large environmental challenge from climate change to biodiversity loss (Crist et al 2017) to pollution (e.g. The Economist 2016a) has not been solved. The key challenge is overcoming the cult of economic growth (O’Neill 2011) and associated anthropocentrism (Crist 2012). These ideologies perpetuate themselves in practice that subordinates environment to industrial development demands (Washington 2015), and in business education that tends to present the triple P’s of People, Profit, and Planet as equal ‘partners’ (Kopnina 2012, 2015a, 2015b). Production systems seem to be oriented towards the only bottom-line, Profit, and in fact, subordinates People and Planet to industrial development and economic growth (Rees 2010; York 2017). Critical sustainability researchers have proposed degrowth (O’Neill 2011) and the transition to the steady state economy with a fixed population and a constant sustainable throughput of resources (Washington 2015). However, as long as the human population continues expanding and material needs remain unsustainably high or continue to rise, there is also an urgent need for the systems of production that radically overhaul the take-make-waste (‘cradle to grave’) manufacturing.

To further this aim, Cradle to Cradle (C2C), the concept developed by McDonough and Braungart (2002) and the circular economy (CE) (Webster 2007) models offer alternative perspectives (Kopnina 2015b, 2017). C2C framework adheres to “waste equals food”, “respect diversity” and “use solar income” principles (McDonough and Braungart 2002). “Waste equals food” refers to materials that circulate either in biological (organic, biodegradable) or technological cycles, which are never wasted in the landfills or destroyed but endlessly reused. “Respecting diversity” implies to both natural (biodiversity) and cultural diversity, or locally informed ways of knowing and making products. The use of “solar income” also extends to other forms of endlessly renewable energy, including wind, kinetic, and tidal waves. The C2C framework suggests that current efforts to mitigate harm through eco-efficiency do not reach deep enough to promote fundamental change.

Current research in sustainability education often involves the conventional models of ‘sustainable consumption’ based on the diffused notion of sustainable development (Kopnina 2012; 2014; Bonnet 2013; Washington 2015). While sustainable consumption in education has also been addressed through the circular models (Webster 2007; Boer et al 2011; Huckle 2012; Kopnina 2013; 2015a; 2016b), the critical evaluation of these transformative models in education has not yet been realized.

This chapter will focus on transformative models of sustainability and discuss the associated challenges at teaching about CE and C2C at vocational and liberal arts school levels. This chapter will

first discuss the background of circular frameworks and then turn to the case study of experiential (practical) and theoretical education in The Netherlands. The sections below will examine production models that reach beyond conventional sustainability with its focus on closed-loop models and then turn to examples from educational practice. In this chapter, I shall explore how students can be taught to distinguish between linear and circular models and how the pitfalls of subversion can be avoided. The following sections will discuss different sustainability models including areas in which subversion is possible. The implications for teaching circular economy to bachelor's students will be discussed within the case study of an experimental online course piloted by vocational schools in Rotterdam, Utrecht and The Hague universities, and Leiden University College in The Netherlands. This course was targeted at increasing students' awareness of alternatives to mainstream production models.

### *Transition to circularity*

Waste has become one of the prominent features of industrial development. According to UN's Food and Agriculture Organization, a third of all produced food, about 1.3 billion tons, is wasted before it reaches the consumer, and about 2 to 5% of meat is thrown away (The Economist 2016b). According to the European Commission, about 162.9 kg of packaging waste was generated per inhabitant in the European Union in 2014, including 'paper and cardboard', 'glass', 'plastic', 'wood' and 'metal' (EC). One of the measures to address this waste is the circular economy.

Based on C2C framework, Ellen MacArthur Foundation has popularized the concept of the circular economy in Europe and Northern America. Based on the Circular Economy Stakeholder Conference held in Brussels in March 2017, the European Commission and the EESC jointly launched the European Circular Economy Stakeholder Platform ([http://ec.europa.eu/environment/circular-economy/index\\_en.htm](http://ec.europa.eu/environment/circular-economy/index_en.htm)). The organizers of this platform bring together circular economy-related networks and platforms; groupings and organizations of businesses, of trade unions and from the civil society; networks of national, regional and local public authorities/bodies and organizations from the knowledge and research communities, think tanks, and universities.

The term circular economy underlies the role of natural diversity as a characteristic of resilient and productive systems and underscores the importance of the process of production in which 'waste' from a production process is used as a resource for new products. This process is known as end-of-waste (EoW) criteria (Zorpas 2016) combining environmental protection and public health, take-back requirements and extended producer responsibility.

Ideally, a circular system not only improves optimizes resource yields and reduces production risks by managing renewable flows but transforms the system of production from the onset. The crucial

point is not dealing with waste after it has been already produced, as most of the conventional sustainability proponents do (for example, G-star, a denim producer, makes some of their jeans out of plastic from the oceans) but *not producing* anything that results in waste in the first place. We note that this is an aspiration, which has yet to be demonstrated by government policies, corporate leaders and the general public.

The idea of circular economy stems from the 1976 report to the European Commission, ‘The Potential for Substituting Manpower for Energy’ written by Walter Stahel and Genevieve Reday (1976). Stahel (1997) has further developed a concept of ‘self-replenishing economy’ through cycling materials and have developed the foundations of what came to be known as ‘functional economy’. The functional economy emphasizes turning products into services through leasing contracts. Stahel (1997) also argued that the functional economy should lead to an increase in jobs as labor is required to keep products in use through each use-phase. Murray et al (2017) define the circular economy as “an economic model wherein planning, resourcing, procurement, production and reprocessing are designed and managed, as both process and output, to maximize ecosystem functioning and human well-being”. The concept of the circular economy is intertwined with other sub-fields and disciplines of industrial ecology and environmental economics where it is seen as a way to limit and ideally keep low and constant the number of resources extracted. C2C and CE framework works with the concepts of biological (organic) and technical (synthetic) nutrients or metabolisms, all materials that operate in regenerative cycles. Understanding of these cycles requires **an** understanding of Life cycle analysis (LCA), also known as cradle-to-cradle analysis, a method to assess a product’s environmental impacts taking into account all stages of product’s life.

The circular approaches are basically critical of mainstream approaches to sustainability that focus on ‘eco-efficiency’ that merely reduce but do not eliminate damage (Brennan et al 2015; Lieder and Rashid 2016). For example, recycling involves down-cycling, as this process requires energy, transportation and are in actuality converted from valuable products into low-value raw materials (McDonough and Braungart 2002). Another example includes “waste to energy” initiatives. While burning trash to generate electricity may appear sustainable, but it is still cradle-to-grave model in which both organic and technical resources are wasted for a short burst of energy (McDonough and Braungart 2002). The same can be said about the use of biofuels (largely advertised as ‘green’ renewable energy source) that are derived from trees, wooden pallets or algae also has a negative impact on forests that would otherwise absorb carbon (The Economist 2015a). Also, biofuels compete for productive agricultural land and threaten biodiversity (Kopnina 2016a). Instead, circular economy and C2C propose production systems and materials without the loss of value, where materials are *endlessly reused* rather than (slowly) degraded. Examples range from pre-industrial production and distribution systems (e.g. milk

directly from the farmer distributed in glass milk bottle that is collected and refilled by the milkman) to hyper-modern designs, including the use of ‘true’ renewable energy sources (Kopnina and Blewitt 2014). By ‘true’ renewables is meant an endless supply of it, namely from wind, sun or air pressure – which are (to be) used in inventions ranging from Hyperloop and solar airplanes.

Another feature of C2C circular economy is dematerialization, and transition from manufacturing to services. In product-service system or PSS (Mont 2002), it is recognized that a consumer does not need a drill but a hole in the wall and companies can provide a drill-leasing service. This means that the product (in this case, the drill) should be durable, but also easily repairable, so it can be shared by hundreds of customers, and ideally, and made of Cradle to Cradle materials.

The application of these ideas is evident in Europe, where PSS’s were largely promoted by environmental agencies (Tukker and Tischner 2017), but also in the rest of the world. In China, in 2002 the government has adopted the circular economy as a new strategy for development (Yuan et al 2006; Geng et al 2016). Part of these circular economy strategies was the establishment of educational centers, programs or curriculum. Ellen MacArthur Foundation, for example, offers free teaching materials and power points to enable engineering, design and business students and professionals to learn more about sustainable consumption and production. Chinese *Law for the Promotion of the Circular Economy* the government agencies stimulate research, development, promotion and international cooperation of science relating to circular economies, as well as supporting the education (<http://www.lawinfochina.com/display.aspx?id=7025&lib=law>).

To further these aims, C2C uses LCA for its certification process. The Cradle-to-Cradle Certification spans over five categories, which include material health, material utilization, renewable energy and carbon management, water stewardship, and social fairness. Based on these categories, the product or process can receive five different levels (Basic, Bronze, Silver, Gold, Platinum), with the lowest level reached in any of these categories determining the final certification. Such assessments need to be both rigorous and continuous in order to avoid the danger of slipping back into unsustainable patterns.

### **The potential risk of subversion of transformative frameworks**

The circular economy models are not without limitations. First, the transition cannot be only top-down. Stegaman (2015) notes that the decisive factor is consumers’ behavior change. Despite the success of Dutch and international collaborative platforms like Marktplaats, Snappcar, Peerby, and Airbnb that offer ‘shared’ services their popularity does not automatically lead to a circular economy (Stegaman 2015).

Secondly, the circular economy is restricted by traditional economic reasoning. Ellen MacArthur Foundation, as well as European Union and Chinese circular economy initiatives, see the circular economy as a "new engine of growth" and the top 'best practice' examples from its website indicate that business, as usual, is happening. In this framing, the circular economy contradicts degrowth discourse (O'Neill 2011) and rejects the need for critically addressing economic growth (Jackson and Senker 2011; Washington 2015). China, for example, uses its CE policies are presently primarily targeted at reduction of waste (Ghisellini et al 2016), as illustrated by the Chinese documentary films 'Beijing Besieged by Waste' and 'Under the Dome'. Chinese industry at the moment shows no clear signs of the overall transition to a circular economy, and maintains unsustainable levels of production and consumption, although some significant strides in sustainability have been made (The Economist 2015b). The unique points of the circular economy framework are put in contrast to conventional economic models in the Rabobank report:

“Circularity does not refer to the macroeconomic process (which is already circular), it refers to making the circuits of materials and goods circular. It is thus not a new economic model, it is foremost about practical and useful thinking to structure an effective economy based on the efficient use of materials and reducing and ultimately eliminating waste flows.... And here we encounter an essential problem in our analysis. In the macroeconomy, the macroeconomic cycle is the focus of the analysis. Not the materials cycle, or the effect on inventories of natural resources or waste” (Stegeman 2015).

Thirdly, circular economy calls for the need to re-organize production processes and product expectations. Rejecting the built-in obsolescence principles of modern production based on continuous purchases means that direct sales of new products will decrease (Brennan et al 2015). Also, currently, remanufacturing seems to be viable in business-to-business niche markets and not so much in consumer markets (Vogtlander et al 2017). Indeed, to enable and accelerate circular economy transition driven by industry, it is necessary to "tap potentials of CE transition scenarios on the company and inter-company level" (Lieder and Rashid 2016, p. 13).

Fourthly, the economy of scale necessary for managing 'waste' of almost eight billion consumers is overwhelming. Even if human excrement is fully re-used for fertilization to complete the biological cycle, the sheer volume of food produced and consumed cannot realistically be turned into 'service economy'. Consumption of meat, for example, results in methane emissions that contribute to climate change and violate animal welfare through CAFO's, or intense feeding operations (Crist 2012). While "feeding the world" is possible, a given better distribution system and more intensification of agriculture (The Economist 2009a), food production and consumption are far from 'circular'. Also, on a greater scale, while consumption and fertility might be falling in some parts of the world, they are increasing in others (The Economist 2009b, 2009c, 2013). For example, consumption of meat is supposed to increase by three

quarters in a few decades as new middle classes in China, India, and many countries in Africa (The Economist 2016b). The circular economy alone cannot reduce the mere volume of food produced and consumed (Rammelt and Crisp 2014). As long as the economy keeps growing the adoption of the circular economy can postpone the time it takes to reach the boundaries of the biophysical envelope (Rammelt and Crisp 2014). Thus, the circular economy in business needs to be understood as most effective in the context of degrowth (O'Neill 2011) and steady state economy (Washington 2015). In education, Huckle (2012) has noted, Ellen MacArthur Foundation's teaching materials, while it is strong on technical aspects of sustainability literacy, were seriously deficient with regard to critical aspects. As the case studies below will illustrate, CE and C2C can also be co-opted to justify "business-as-usual" economic growth models, wrongly assume that easy consumer behavior change will be easy, and ignore the challenge of increasing population and material demands.

### **Case studies**

The Netherlands has been involved in a number of educational activities already involving awareness of circular economy, some of them described by Boer et al (2011). More recently, the initiatives have included The Dutch foundation Duurzaam Geleerd (SDG, Learning for Sustainable Future) that specifically promotes C2C and circular economy in secondary education (<http://mycircularfuture.com/en/>). The courses below represent how integrating C2C and circular economy can be achieved in general sustainability courses, targeted both at practical skills and theoretical knowledge development. What makes the courses described below unique is that aside from introducing general concepts of sustainability and circularity, the curriculum was focused on the development of critical thinking also in regard to issues mentioned in the introductory sections (detailed description of the content is found on Kopnina in print). In the case of IBMS departments of vocational schools, the method of instruction was a series of lectures discussing circular framework in the context of business operations. A more theoretical course at Leiden University College delved deeper into some of the literature and debates mentioned in the Introduction and 'Potential risk of subversion of transformative frameworks' sections of this chapter.

### ***Case studies vocational schools***

This case study is based on the minor Circular Economy in the Cloud, an online course piloted by Universities of Applied Sciences (vocational schools) in Rotterdam, Utrecht, and The Hague International Business Management Studies (IBMS) departments. The author of this chapter was in the position of

tutor/assessor. The main objective of this course, given between September 2014 and February 2015, was to teach students what circular economy is and how small companies and start-ups (SME's) could make the transition from a linear to a circular model of operation. 68 students were initially enrolled in the minor. The author of this chapter has supervised two teams of students with four students in one group and five in another group. All students had a background in international business, marketing, finance, and branding. Seventeen companies were selected on the basis of their interest to participate as they expected to benefit from the practical solutions. The intention was that students help companies to enable the transition to a circular production model and simultaneously offer a competitive advantage over their “linear” competitors. The two teams that the author has supervised cooperated with a company that made bridges (“Bridges”) and a company specialized in renting camping equipment (“Tents”).

Bridges was founded in 2012 and separated into three departments: Engineering; Research and Development/ Innovation; and Products (bridges and pipes). The student group worked with the Products division. As outlined on the company’s website, the bridges of Bridges company have the following advantages: “Expected lifetime of hundred years, no maintenance required, easy to implement, and zero erosion from nature” (Company website is anonymous). The bridges are manufactured from steel, plastic, resins, and fiber, which are provided from two main suppliers. Additionally to a report advising how the company should apply the circular economy concept to their business, market expansion was one of the central aims of the student project. Apart from the conventional wooden bridge manufacturers in The Netherlands, there was one main composite bridge manufacturer with a capacity of 100 bridges annually, leaving a capacity of 400 bridges to be targeted. In the long-term, the company wanted to expand its operations to other European countries.

Tents company’s main business is renting airbeds, tents and sleeping bags, delivered to festivals. Tents claimed that it was able to reduce the carbon footprint of festivals by recycling the tents into a high quality granulate used for future tents. According to the company’s website, the tents are made from 100% recycled film, or Plasticulture, that is also used in agriculture. Through a deposit scheme, Tents encourages the users to return the used tents to the materials’ supplier, claiming to be a green company. One of the tasks that the company assigned to students was to help further improve its green credentials by providing advice as to how to make its operations more ‘circular’. The company’s greatest interest, however, was in expanding its market to the United Kingdom (UK). According to guidelines given to students, the plan needed to contain an outline of festivals, attendees, turnover, margins, archetypes of the UK-festival market, a list with possible partners and analysis of the competition.

### ***Findings at vocational schools***

In the case of Bridges, in their evaluation interview with the instructor, the students reflected that they were refused information about the material used in the whole supply chain. One of the students has reflected: "I think they [the company] had no interest in the circular economy in the first place. I think they were just thinking of expanding... and we [as business students] could help them...". Indeed, as reported by other members of the group, the most important objective of student participation, as far as their sponsor was concerned, was to make a comparison between wooden bridges and composite bridges and provide the client with an analysis that focused on sustainability. This report was to be based on the research of the business processes of two competitors, specifically the value chain. In their research, in accordance with the company's wishes, the group was set out to advise Bridges how to create a competitive advantage based on the value chain and material analysis, no matter how circular or linear the processes are. In their desk research about materials used for bridges, students distinguished synthetic fibers, and the natural raw materials used to create synthetic fibers. The former include raw petroleum (carbon), silica (glass), and basalt (ceramic) and natural fibers found in plants. The latter include cellulose fibers, animal (protein) fibers and minerals (such as asbestos, which is now banned due to its carcinogenic qualities). Students have found that while some materials have offered good examples of either biological or technical nutrients, it was the 'hybrid' synthetic materials that were preferred by the company. However, changing materials to more sustainable ones it would require an overhaul of the existing business model. The company supervisor has communicated to the students during the last stage of their project that the Bridges will remain true to its original business model as it "proved to be profitable". The feasibility assessment consisted of an evaluation of the company's and competitors' value chains and suggestions about how Bridges can be promoted as being more sustainable than competitors.

As for the Tents, in analyzing inbound/outbound logistics of Tents the students noted that the current products are brought from China to be transported to the targeted locations at the festivals or the homes of the clients in The Netherlands. The materials used were mostly recyclable plastics and cotton fiber mass. The students noted that the current way that the products are produced and transported result in high costs and CO<sub>2</sub> emissions. The students have contemplated production at local sites, finding local suppliers and revising outbound logistics. They have also suggested the use of materials that could extend the longevity of the tents to make them more suitable for refurbishing, using a tent repair kit. The main renting service could be supported by additional services, such as cleaning, repairing and, if needed, replacing inner tents. The students have noticed that domestic production, as well as repair and other services, will be costlier than the currently employed system. The company's director has admitted that the current model is far from being a complete circular economy operation, but that his company would be willing to take the necessary steps if a transition was feasible within the current business model. All student suggestions, however, have led the team as well as company supervisor to a conclusion that a

complete revision of the presently used business model will be necessary to achieve recommended improvements. The company seems to have followed the habitual course without notable changes.

### ***Reflection on student projects at vocation schools***

In student projects, the “business as usual” expertise was sought after – students' expertise in marketing, branding, and finance. Perhaps unintentionally, it appeared that the reports of business students could help companies to underline their comparative advantage of being green. The Tents company supervisor, in a meeting with this researcher, has admitted that changing production processes, including materials and transportation, will not be considered, as the company has no surplus capital to invest in this costly change. Confronted with the need for the radical overhaul of established practices within the entire supply chain and the question of financial viability, the company practically withdrew its ambition for the transition. The students have reported that they have learned that the transition was not really feasible.

The real-life examples have confronted both students and companies with difficulties of linking one small company to global supply chains in such a way that all stakeholders – from producers of raw materials to consumers – could contribute to the overall re-orientation of the manner of production. As a result, the students felt disappointed, reporting that the companies were not willing to take their advice on board and doubting in general whether the transition to a circular economy is possible. While the students were able to make recommendations for expansion of the existing business into the international market, they could not contribute to the circular mode of operation. However, in the evaluative meeting with the students, they have reported that they did gain critical learning experience.

### ***Case studies Leiden University College (LUC)***

The author was also involved in the instruction of students of the advanced course Environment and Development (E&D) at Leiden University College (LUC). For the course was offered between August 2015 and March 2017. As in the case of vocational schools, the author of this chapter was in a position of tutor/assessor. In the course's individual assignments, the students were asked to reflect upon the difference between conventional (eco-efficiency, reuse, reduce, recycle) and circular sustainability frameworks. These assignments, as well as detailed course structure, are described in Kopnina (in print).

### ***Findings at LUC***

The students demonstrated that they have grasped theoretical background and origin of the concepts. One student has reflected in their writing assignment:

“Instead of focusing on continuous growth and expansion, the circular economy envisions a closed loop of regeneration and reuse (Kopnina and Blewitt 2014). The concept is widely used in the fields of industrial ecology and environmental economics, where it is seen as a way to both minimize the waste-flow into the environment (Andersen 2007). Inspired by circular systems in nature, the proponents believe that the current volumes of human waste are unnecessary (Stahel 2016). Reuse of products if possible, and recycling the remnants of a product when it can no longer be refurbished are at the core of the circular economy’s logic (ibid.). There is also a need to change thinking and behavior. For the circular economy to be successful, definitions of ownership and the positive connotation of having something new need to be reconsidered. Collaborative models of consumption (‘the sharing economy’) can significantly reduce the human environmental impacts by decreasing levels of consumption (Ghisellini et al 2016). The effectiveness of many products could increase spectacularly if they were to be shared instead of stored somewhere without a purpose. Next to that, because ownership gives way to stewardship, systems where the producer retains ownership over a product while the consumer only pays for its usage, give producers more incentives to make durable products that can be reused and ultimately recycled (Stahel 2016)”.

The distinction between eco-efficiency and eco-effectiveness was identified. One student wrote in his essay:

“Focusing on production, two schools, broadly speaking, can be identified: eco-efficiency and eco-effectiveness (Golinska 2014). The former can be called the more traditional and conservative, which has as its core aim to reduce the harmful effects of production and consumption. Arguably, eco-efficiency supports the exceedingly modest goal of making business as usual “less bad”. Braungart and McDonough (2002) argue that eco-efficiency harms the cause it is supposed to serve as it fails to acknowledge the urgent necessity of radical sustainable innovation and confront issues like toxicity in material flows.”

One student wrote her essay about Narayana Peesapaty’s Bakey’s edible spoons and other utensils. These spoons are made of water, sorghum flour, rice flour, and wheat flour, without preservatives and pesticides (<http://www.bakeys.com/>). The locally-produced millet can be naturally flavored and turned into cutlery requires little water compared to rice (Sadras et al. n.d.). Bakey’s business model is based on Kickstarter, a crowd-funding organization that is largely sponsored by American investors and consumers, and as the majority of interested donators come from the United States.

In her report, this student has reflected that it is unknown how the factory producing spoons is run and whether it uses solar energy is unknown. Also, the “exact manufacturing process remains a mystery”. The student found the Bakey’s distribution system especially worrying as mostly using lorries within India. Yet, the major demand for spoons comes from Americans that have sponsored the company via Kickstarter. While according to the Bakeys' website, the spoons... “should be used in rural India by people who sell food on the street” (Bakeys n.d.), flying spoons to America defeats their purpose. Also, due to American food and safety regulations, the spoons had to be delivered in plastic packages. In

reflecting on this paradox, the student makes a more general comment about the risk of subversion of C2C:

“It is indeed their consumption that allows Peesapaty’s edible spoons to be a viable business concept at all, but it is also this consumption that makes it problematic. It highlights the problems that I have with the Cradle to Cradle concept. I would prefer people to use metal cutlery that lasts for decades and not because current consumers use plastic cutlery instead”.

Another aspect of this criticism is the socio-cultural system of inequality:

“It is mostly people of a lower caste who use plastic cutlery when consuming street food because, after using it, the things they touched are considered no longer suitable for those of higher social standing. The real problem here is the use of plastic cutlery – the result of caste discrimination in India where it is simply not possible to grant access to metal cutlery to untouchables – and the fact that demand for edible spoons is currently highest in the United States”.

*Table 1 Table listing ingredients of Bakeys and Polypropylene spoons, and the environmental impacts of those ingredients.*

<i>Type of spoon</i>	<i>Ingredients</i>	<i>Origin</i>	<i>Renewable?</i>	<i>Environmental impacts</i>
<i>Polypropylene</i>	Ethane	Petroleum oils and coal	No	Usage of these kinds of compounds leads to carbon emissions and thus contributes to climate change.
	Propane	Natural gas, light crude oil, and oil-refinery gasses	No	Usage of these kinds of compounds leads to carbon emissions and thus contributes to climate change.
	Butane	Natural gas and crude oil	No	Usage of these kinds of compounds leads to carbon emissions and thus contributes to climate change.
	Naphtha	Distillation of hydrocarbons	No	Usage of these kinds of compounds leads to carbon emissions and thus contributes to climate change.
	Petroleum	The earth’s crust	No	Usage of these kinds of compounds leads to carbon emissions and thus contributes to climate change.

<i>Bakeys</i>	Ziegler-Natta Catalyst	Halides of titanium, chromium, vanadium, and zirconium. Alkyl aluminum compounds	No	Toxic to the environment and humans
	Water	Rivers and other freshwater basins	Depends on abundance (UN-Water WWAP)	Misuse of water could lead to water scarcity, for both humans and ecosystems, especially in arid regions
	Sorghum flour	Agriculture	Yes	Land use change, water use.
	Rice flour	Agriculture	Yes	Land use change, water use.
	Wheat flour	Agriculture	Yes	Land use change, water use.

The student noted that for polypropylene spoons, polypropylene is created first by steam cracking propane and butane, steam cracking naphtha or by catalytic cracking of gas oil. This is a process using several chemicals. The propylene gas created then has to undergo a process with the Ziegler-Natta catalyst and a solvent, which is called polymerization and then, under high temperature, molded into a spoon shape. A schematic depiction of the process from propylene to polypropylene can be seen in figure 1 below.

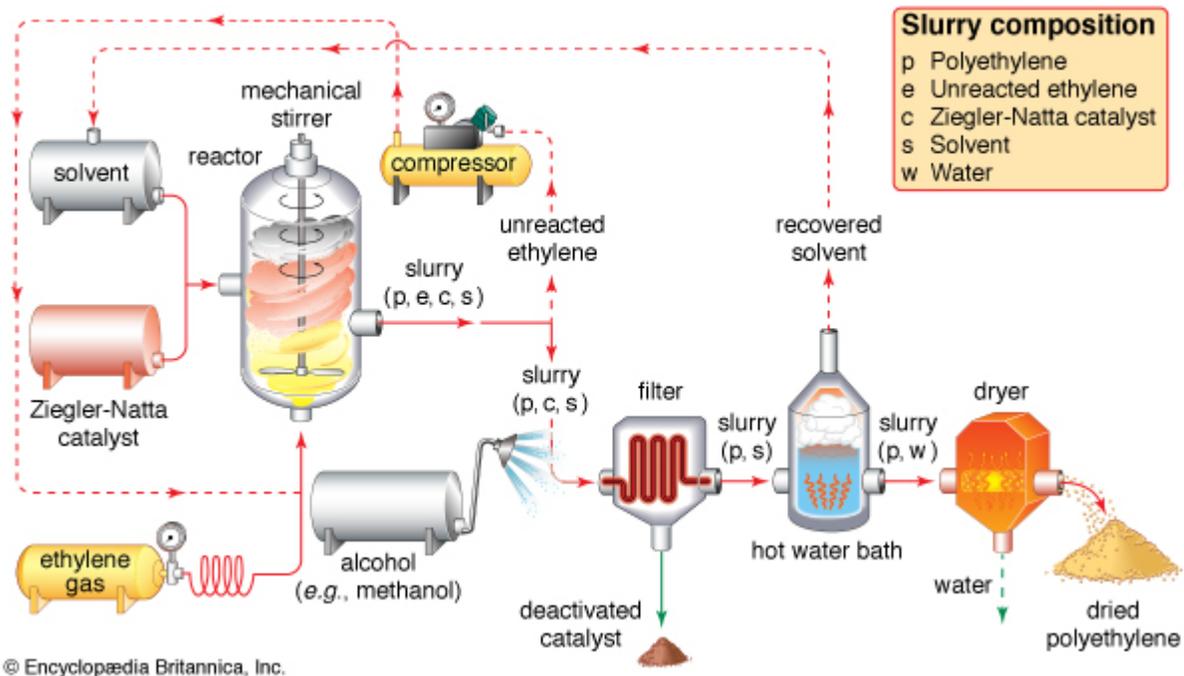


Figure 1 Schematic depiction of the Ziegler-Natta polymerization of ethylene, for polypropylene, replace ethylene gas with propylene gas. Source: adapted by a student from Encyclopaedia Britannica.

Indeed, one of the issues with C2C, as noted by the student, is that certain ‘good’ products, such as metal spoons that last for generations, already exist. As the student notes, the use of existing products may be more sustainable than the consumption of more and more ‘revolutionary’ C2C products. The larger question of economic growth and consumerist culture needs to be addressed:

“If one were to criticize manufactures, it should be planned obsolescence they target, not necessarily their production methods. A disposable shoe may not have as much of an environmental impact when disposed of than a pair of hard-leather shoes, but in the end, more resources – with the pollution that often accompanies it – have to be spent producing new pairs. Manufactures should make products that are built to last, and consumers should use them until they break – or give them away when they no longer like them – rather than throw them out.... The point is to decrease our ecological footprint; then why do we not implore the consumer to buy second-hand – even if such products are not strictly C2C – and give away rather than disposing of products that are no longer wanted? Even if one argues that they are just working within the framework of contemporary consumerist culture, Braungart and McDonough do then not take into account economies of scale. In other words, C2C either does not properly address consumer culture as a theory, or it does not address economic reality as a practice.... Cradle to Cradle draws our attention away from the sustained use of long-lasting products to products that may sustainably be disposed of. As the authors of the C2C like to accuse other approaches to sustainability of greenwashing, it is only right to point out that they are essentially guilty of the same practice”.

Adding to this, the student reflects that while changing consumer behavior is difficult, the responsibility of consumers is necessary to cut down production. Reflecting on the role of consumers and not just producers needs this student wrote:

“The problem does not necessarily lie with the manufacturers of cradle to grave products; it is instead the consumers we should blame for the current situation. Braungart and McDonough claim that it is up to industrial designers and manufacturers to produce goods with a small footprint that are easily re-used, or that we return to pre-industrial ways of manufacturing that, in my experience, nobody really desires. The first is unattainable due to economies of scale – such products will remain luxury goods until we are able to mass-produce them, after which they will no longer be desirable because they are then very commonly-used and the second is rather patronizing to those who do not enjoy the same standards of living that we in the West do”...

Another student investigated Ellen Mac Arthur Foundation website and found the Coca-Cola Enterprises’ ‘base case study’ commitment to “maximizing the usage and value of the plastics used in bottle production” (EMF 2016). The student discovered that the company’s trademarked ‘PlantBottle’ is in fact *partially* (up to a maximum 30%) based on plants (Coca Cola 2012). While Coca-Cola claims that the plant-bottle packaging has reduced emissions (Coca-Cola 2015), the company seems to have no serious plans about recycling let alone re-using the bottle after its content has been consumed (Terry 2011). In fact, the plant-bottle represents a case of ‘monstrous hybrid’ (Braungart and McDonough 2002), a mix of biological and technical nutrients that can neither be recycled or safely disposed of.

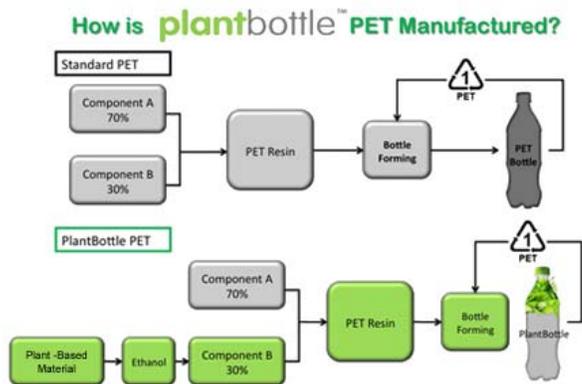


Figure 2 PlantBottle PET. Source: adapted by a student from Coca Cola.

“In an analysis of Coca-Cola's efforts to adopt a more circular economic-model for its plastic bottles shows that some initiatives are not as transformative as one would expect them to be based on the CE framework. The paper concludes that for the circular economy to have an impact, all actors should really start to walk-the-talk and go beyond symbolic language and small measures. Truly transformative change by both government and private sector is necessary to reduce human environmental impact and to protect ecological systems”.

Another case discussed by the student is that of Satino Black hand towels produced by the Dutch company Van Houtum. The student notes that presently, in the U.S. alone, more than 13 billion pounds of paper towels, created of tree pulp, water, chemicals, and energy, are used annually. Globally, 254 million tonnes of paper towels are disposed of every year. The paper towels are distributed to the consumers by first delivering it to grocery stores in trucks or ships, to be consequently used once and dumped in the mixed garbage container. In Van Houtum's product, all hazardous chemicals have been phased out and substituted by biodegradable alternatives. To reduce transportation, Van Houtum exports no further than Greece. The company is also not planning on expanding its exports, but rather aim for "value-increase".<sup>1</sup> The hand towels were certified in 2010, and its C2C scorecard is displayed in Figure 3.

Figure 3: C2C scorecard for Black Satino hand towels

SATINO BLACK HAND TOWELS VAN HOUTUM B.V. Certification Standard Version 3.0		SILVER				
		BASIC	BRONZE	SILVER	GOLD	PLATINUM
	Material Health			✓		
	Material Reutilization					✓
	Renewable Energy				✓	
	Water Stewardship				✓	
	Social Fairness				✓	

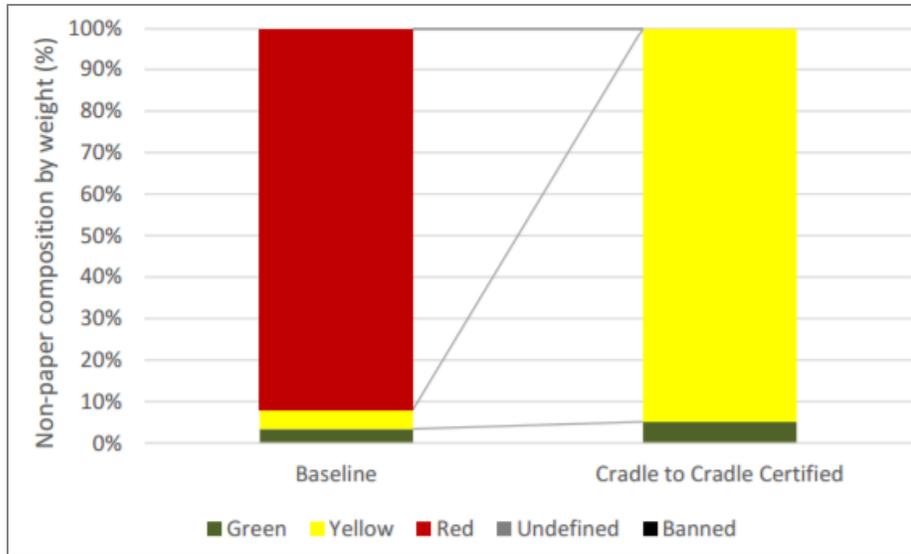
The student further discussed C2C certification impacts on the five quality categories and outlined the following:

- i. *Material health:* This quality category assigns each material used for the product of a material health rating. The rating is based upon a thorough analysis of the toxicity of the materials,

<sup>1</sup> “Van Houtum Aims to Better Substantial Value Growth in Washroom Solutions | Tissue World Magazine.” Accessed October 25, 2016. <http://www.purpleprint.eu/twmagazineclon/featured-slider/van-houtum-aims-to-better-substantial-value-growth-in-washroom-solutions>.

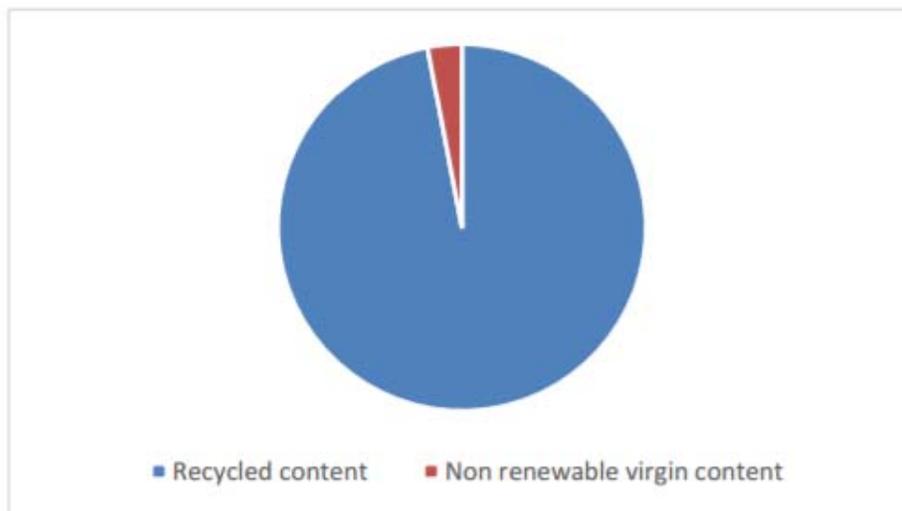
including the hazards associated with the disposal of the product. A 'green' rating means that the material is supporting C2C's objectives, a 'yellow' rating means that there are moderately problematic properties of the material, and a 'red' rating means that there are highly problematic properties of the material, meaning that it should be phased out in order to optimize a product. Material health in Satino Black paper towels has been rewarded the 'Silver' stamp, making it the least score of all five categories. When compared to the material health of its non-C2C equivalent, it becomes clear that the Satino Black hand towels scores way higher: all 'X' or red rated chemicals are removed from the product and packaging. Figure 3 gives an overview of the material health's performances of both products.

Figure 4 Material health of hand towels before and after certification



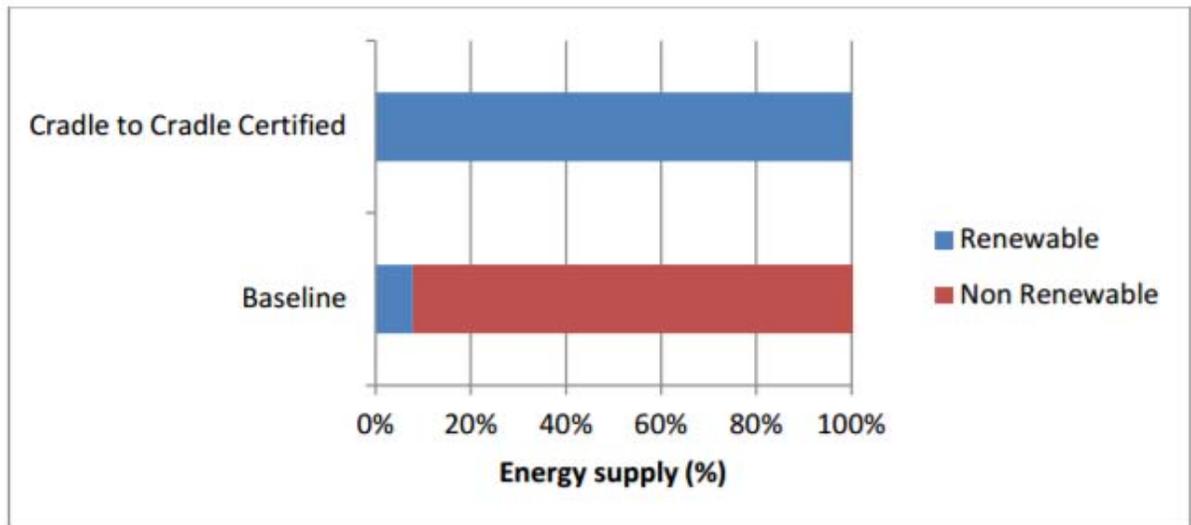
- ii. *Material reutilization:* The Satino Black hand towels are produced almost fully from recycled paper. This was identical before and after certification. In this category, the hand towels have been rewarded the 'Platinum', which means that the product is designed in such a way that it is intended for the technical and/or biological cycle, and more than 80% of the nutrients used are reutilized.

Figure 5 Recycled content of hand towels



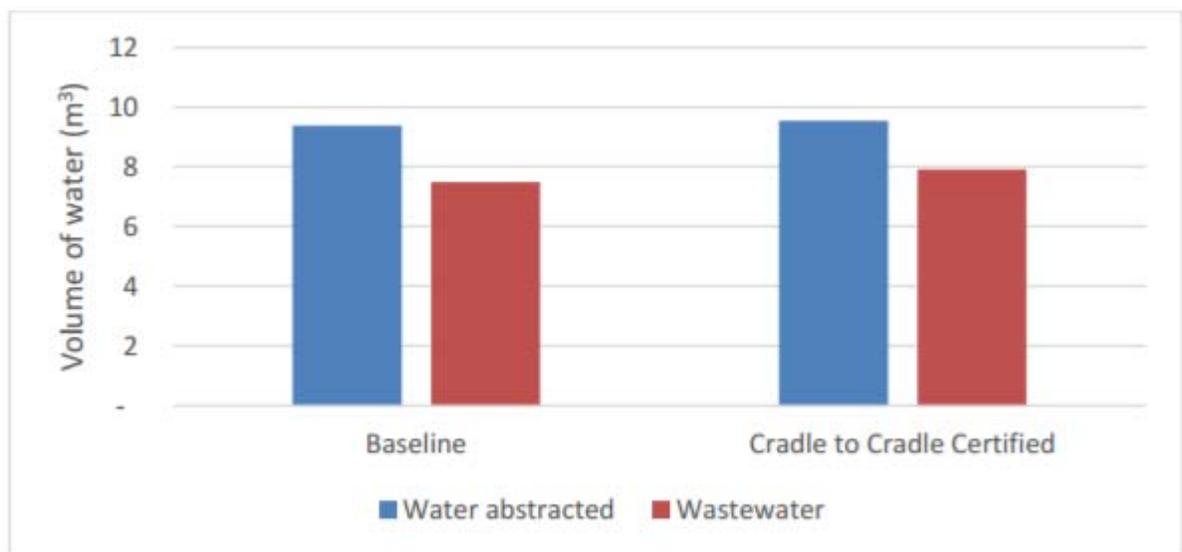
- iii. *Renewable energy and carbon management:* The current hand towels score ‘Gold’ on this category, which is achieved through energy management optimization (i.e. less demanding production and better energy sourcing). In 2008 (before certification), the consumption of renewable energy for the production of the hand towels was at 8%. In 2012 the consumption of non-renewable energy was at 100% (from green gas and hydroelectricity).

Figure 6: Percentage of renewable energy used in the production of hand towels before and after certification



- iv. *Water stewardship:* The hand towels have been rewarded the level ‘Gold’ for this category. Both the amount of abstracted water and the amount of wastewater per tonne of the product have remained nearly the same before and after certification. The amount of abstracted water even appeared to be a bit higher after certification, but according to Van Houtum, this is not related to certification, but rather to the fact that water consumption is measured at the site itself, which allows for discrepancies.

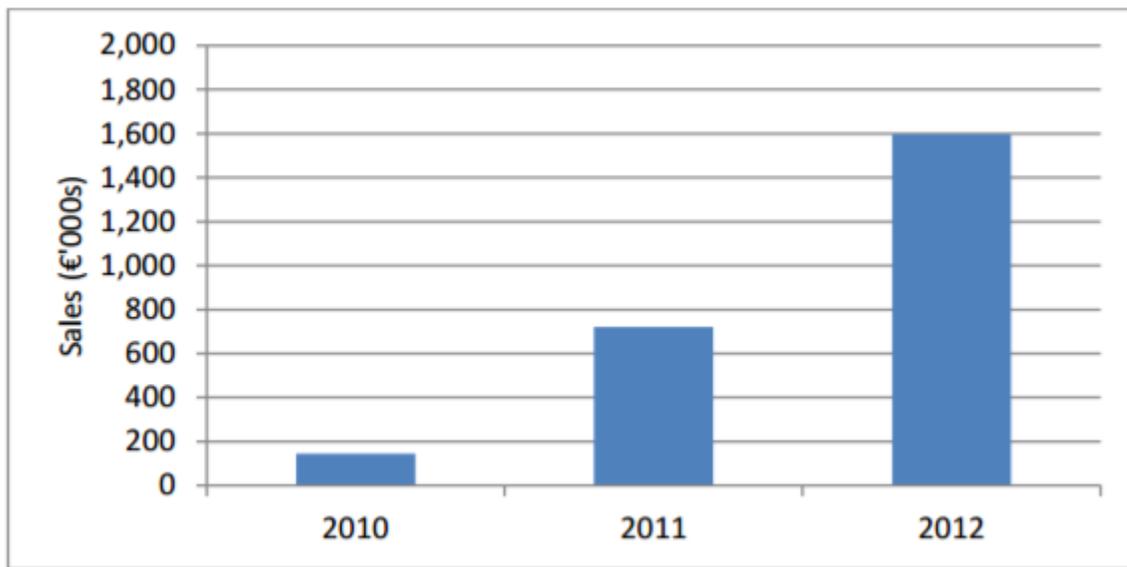
Figure 7: Water consumption of product before and after certification



- v. *Social fairness*: Van Houtum has been rewarded the level ‘Gold’ for this category. Van Houtum has not changed its view/policy towards social responsibility since certification of the hand towels. Every year, the company produces a social responsibility report.<sup>2</sup> Furthermore, the two processing sites are monitored and certified, making sure that the sites meet the minimum safety and health requirements.<sup>3</sup>

The student has noticed that since Satino Black hand towels’ certification in 2010, sales have increased significantly. According to Van Houtum, the C2C certification has been a competitive advantage and suppliers down the chain became more involved by offering ideas, thoughts, and innovations on further improvements.<sup>4</sup> Figure 7 shows that between 2010 and 2012, sales went up significantly.

Figure 8: Sales of product since C2C certification



In conclusion, the student found that C2C certification for the Sativa Black hand towels had a positive influence on all five of the quality categories as well as resulted in a significant increase in sales of the product. The student further reflected that although the C2C certification is not meant to be an innovation driver, it is a way for companies to show their progress towards a more sustainable product. The student noted that

“a heavy emphasis often lays on the business benefits of C2C certifications, i.e. promoting the financial benefits to encourage environmental awareness. This could be explained by looking at the notion of anthropocentrism: due to our nature, humans are more likely to respond to self-interest motives”.

<sup>2</sup> Van Houtum. ‘CSR Report 2015’. <http://www.vanhoutum.nl/en/csr/2594/csr-facts-and-figures.html>.

<sup>3</sup> “People - Van Houtum.” Accessed October 25, 2016. <http://www.vanhoutum.nl/en/csr/vision-mission-policy/2586/people.html>.

<sup>4</sup> “Succes Met Cradle-to-Cradle Toilet paper | Supply Chain Magazine.” Accessed October 25, 2016. <http://www.supplychainmagazine.nl/succes-met-cradle-to-cradle-toiletpapier/>

Some government agencies also use Ellen MacArthur's foundation's platform, even though their policies might not be strictly 'circular'.

“One of the policy-oriented case-studies is the Dutch ‘Green Deal’ approach (EMF 2016a). The Green Deal is an initiative by a couple of Dutch governmental ministries to facilitate sustainable initiatives... Although the Foundation’s website (EMF 2016a) makes it look like the Green Deal is meant only for projects that fit the circular economy model, the Green Deal website (2016) explains that the project is meant for a broader range of sustainable initiatives. In fact, most of the Green Deals at this point are focused on emission reduction, mainly addressing symptoms rather than their underlying causes of unsustainability. For example, one of the recently established green deals is focused on reducing emissions of mobile machinery by 10% in various construction sectors. It aims to do so mainly by teaching the (engine) drivers how to operate the machines in ways that produce fewer emissions. However, to get closer to the core of the problem one would have to think about how these machines could not be fuelled by fossil fuels. To be truly transformative one should consider whether many of the construction projects should be initiated in the first place when there are also many existing structures that could be refurbished. Decreasing the number of demolition- and construction projects would reduce emissions, resource extraction, and waste”.

Pondering applicability of C2C and CE, one student reflected:

“There are certain limitations to the implementations of these models and their measures. Cradle-to-Cradle and the Circular Economy certainly actualize theoretical conceptions and enhance one’s ability to partake in private sphere environmentalism (Kopnina and Blewitt, 2014). However, these measures alone cannot solve the paradoxes and complexities of environment and development. Cradle-to-Cradle creates a more sustainable method of production, yet Circular Economy alone cannot address rampant consumerism and overpopulation. These efforts must be implemented amidst a growing ecocentric dialogue that also accounts for macro-environmental responsibility, and only when this convergence of private and public measures to create sustainable development can this goal truly be achieved”.

### **Reflecting on written assignments at LUC**

Promising directions in achieving circular production and consumption were outlined by the students, such as greater sensitivity to socio-cultural context, as in the case of utensil used for lower castes in India. Many students at LUC have called for more attention to consumer responsibility. As one of the students suggests the necessary change requires that consumers reconsider their “definitions of ownership and the positive connotation of having something new” and willingly engage in sharing economy. When comparing ‘ideal’ frameworks and real-life products the students noted that political and economic constraints need to be taken into account. Furthermore, some students have reflected that economic motive is indeed important, as noted by the student in the case of C2C certifications where “heavy emphasis often

lays on the business benefits”. When profit and sustainability go hand in hand, this should not be a problem.

Less optimistically, some students felt that the circular economy framework does not account for material consumption that cannot be serviced, shared, or ‘dematerialized’. Indeed, as one of the students reflects, ‘Circular Economy alone cannot address rampant consumerism and overpopulation’. One of the most risks identified by students involves the “rebound effect” (Greening et al 2000) – consuming more products because they appear to be green. This point was made by the student commenting on Bakeys' edible spoon and the fact that using one metal spoon for a lifetime might have been a better solution than to keep producing new materials. Indeed, as one student states in the case of construction: "one should consider whether many of the construction projects should be initiated in the first place, when there are also many existing structures that could be refurbished” or spoons: “use of existing products may be more sustainable than the consumption of more and more ‘revolutionary’ C2C products”.

“Rebound effect” can be also seen in the way this student has critically presented the desire of C2C to produce more products, and questioned whether consumption can be limited by changes in consumer behavior. One of the largest risks identified by the students in relation to company operations or government policies is greenwashing and window-dressing. In the case of Coca-Cola, the student observed that the ‘plant bottle’ presents a perfect case of ‘monstrous hybrid’ without any plans for reuse. In a similar way, entire government policies, such as the Dutch Green Deal discussed by another student, can be subordinated to the service of business-as-usual. The student evaluating Satino Black towels related her doubts about ‘green gas’ energy.

The student assignments illustrate that many companies or government initiatives continue to produce and sell new products, as in the case of edible spoons while metal cutlery that can last for generations already exists. But using a circular economy for economic gain misses the point of critique of economic and population growth as the driving force behind unsustainability (Washington 2015). Significant in this regard is that governments channel the economic growth ideology to consumers via the media (e.g. Jackson and Senker 2011). This economic reasoning is often internalized by consumers, which makes “consumer-driven change” and individual responsibility suspect (Bansel 2007). The Dutch political initiative the Green Deal, for example, in the words of student attempts to convince the public that environmental measures currently in place are sufficient without the need for radical change.

All this has implications of how students are taught – not just about a revolution in production – although this is necessary – but also about larger demographic and societal challenges. As Huckle (2012) noted, the development of critical literacy is crucial in this respect, in understanding the cultural practices that may help or hinder the related forms of production and consumption. It is also crucial to engage students in a discussion of addressing population growth – through the exercise of women's rights

including the prohibition of child marriages, free provision of contraception, and raising educational levels in countries with a high level of unwanted pregnancies (Crist et al 2017). After all, keeping a balance between different elements in the natural ecosystem is part of Cradle to Cradle philosophy. Indeed, in the courses described (see Koprina in print) the lecturer employed a discussion of underlying causes of unsustainability and alternative ways of measuring growth that include the well-being of humans and the environment. This includes an economic system in balance with people and the planet, such as a steady state economy (York 2017). The assignments discussed in this chapter point out that students' already engage in critical thinking and exhibit healthy skepticism. Instruction can help them to remain pragmatic but also, crucially, committed to transformative measures.

Indeed, what is meant by pragmatism here is that transition from linear to the circular model requires "economically feasible value recovery activities" (Lieder and Rashid 2016, p. 13).

## **Conclusion**

This chapter has raised a number of questions related to ideal and feasible options for, in general, sustainable consumption and production, and for approaching these options in educational practice. When noting potential pitfalls in both practice and teaching of circular frameworks, it is important not to become overly committed either to the optimistic win-win scenarios that might be unrealistic or to all-down skepticism. Indeed, in order to address sustainability challenges we may need to reengage individuals – and in this case students - in their roles as citizens, helping to effectively and fairly regulate resource use and waste production (Isenhour 2015). The role of the student-citizen is in this case related to both staying critical – especially in cases regarding greenwashing – and yet able to remain open to the possibility of implementing 'ideal' practice. Such re-orientation would require the willingness of schools, sponsor companies, and students radical to engage intelligently with evaluating both feasible and ideal sustainability options. The emerging studies of circular economy in education indicate that students need to be taught about both consumer- based (thus, their own) and production-focused (thus, that of larger players) behaviors in order to address the transition to a circular economy (Huckle 2012; Koprina 2015a).

For example, while it might be impossible to build a bridge using 100% organic fibers or to produce enough edible spoons without using fossil fuels, this does not mean that 'green' bridges or edible spoons cannot be sustainably produced on a smaller scale. A compromise between what is financially feasible and desirable is the core challenge that the companies face. Evaluating the "circularity value" of actual products and services and the entire supply chain needs to be part and parcel of both corporate and teaching practice.

The "sustainability value" of circular economy courses requires the students' ability as conscious consumers or future producers and managers to come up with solutions without resorting to pure

economic reasoning. However, even the most conscious consumers can hardly influence large players such as governments and corporate decision-makers, as their power is limited to small committed groups (Isenhour 2015). Such committed groups are indeed the very students who have followed sustainability courses. Education for sustainability can certainly help to ‘engage the unengaged’ – students who just want to get a good internship and eventually a job without the burden of thinking about the trade-offs of economic development and humanity’s dire predicament. Being in a classroom with like-minded individuals, being able to reflect on and discuss the barriers and bottlenecks critically, might help students to carry their insights into the real world. Hopefully, together with lecturers, students can align around the intention to transition to a circular course of production, but also be able to engage meaningfully in global debates about population and consumption. The students’ combined networks are potentially global; they include families, friends, neighbors and business colleagues as well as more remote online networks. It is my hope as a lecturer that these students will be able to carry their critical ability and insights forth.

## References

- Andersen, M. (2007). An Introductory Note on The Environmental Economics of the Circular Economy. *Sustainability Science* 2 (1): 133-140.
- Bakeys Foods Private Limited. n.d. ‘Why Edible Cutlery.’ Accessed 26 October 2017. <http://www.bakeys.com/why-edible-cutlery/>
- Bansel, P. (2007). Subjects of choice and lifelong learning, *International Journal of Qualitative Studies in Education*, 20(3): 283-300.
- Blüdhorn, I. (2007). Sustaining the unsustainable: symbolic politics and the politics of simulation. *Environmental Politics*. 16, 251–275.
- Boer, P., van Heeswijk, J., Heideveld, A., den Held, D., Maatman, D. (2011). *Inspired by Cradle to Cradle: C2C practice in education*. Hiteq, Hilversum, The Netherlands.
- Bonnett, M. (2013). Sustainable development, environmental education, and the significance of being in place. *Curriculum Journal*, 24(2): 250-271.
- Brennan, G., Tennant, M., and Blomsma, F. (2015). Business and production solutions: Closing the Loop. *Sustainability: Key issues*. H. Kopnina and E. Shoreman-Ouimet, eds. New York: Routledge.
- Coca-Cola Company (Coca-Cola). (2015). “Introducing PlantBottle.” Accessed October 26, 2017, at <http://www.coca-colacompany.com/videos/introducing-plant-bottle-ytaevvjxqwaz8>.
- Coca-Cola Company (Coca-Cola). (2012). “2011/2012 Sustainability Report: Sustainable Packaging.” Accessed 27 October 2017 at <http://www.coca->

[colacompany.com/sustainabilityreport/world/sustainable-packaging.html#section-managing-packaging-to-manage-risk](http://colacompany.com/sustainabilityreport/world/sustainable-packaging.html#section-managing-packaging-to-manage-risk)

- Crist, E. (2012). Abundant Earth and Population. In P. Cafaro and E. Crist (Eds). *Life on the Brink: Environmentalists Confront Overpopulation*. Athens, University of Georgia Press. (p. 141-153).
- Crist, E., Mora, C. and Engelman, R. (2017). The interaction of human population, food production, and biodiversity protection. *Science* 356: 260–264.
- EC (European Commission). Packaging waste statistics. [http://ec.europa.eu/eurostat/statistics-explained/index.php/Packaging\\_waste\\_statistics](http://ec.europa.eu/eurostat/statistics-explained/index.php/Packaging_waste_statistics)
- The Economist (2009a). Feeding the world: If words were food, nobody would go hungry. November 21. P. 61-63.
- The Economist (2009b). The baby bonanza. August 29, pp. 20-22.
- The Economist (2009c). Falling fertility. October 31, pp. 13.
- The Economist (2013). Demography in Latin America: Autumn of the Patriarchs. June 1, p. 47.
- The Economist (2015a). Thin harvest: Biofuels. April 18. Pp. 69.
- The Economist (2015b). Saving fish and bearing teeth. April 18. Pp. 52.
- The Economist (2016a). Worse than Beijing: Pollution in India. November 12, p.48.
- The Economist (2016b). Wrap stars: Retailing and the environment. December 17. Pp. 56-57.
- Ellen MacArthur Foundation (EMF). 2016. “History”. Accessed October 25, 2017, at <https://www.ellenmacarthurfoundation.org/about/history>.
- Ellen MacArthur Foundation (EMF). 2016a. “Case Studies”. Accessed October 25, 2017, at <https://www.ellenmacarthurfoundation.org/case-studies>.
- Foster, J. B. (2012). The planetary rift and the new human exemptionalism: A political-economic critique of ecological modernization theory. *Organization and Environment*, 25, 211-237.
- Ghisellini, P., Cialani, C. and Ulgiati, S. (2016). A Review on Circular Economy: The Expected Transition to a Balanced Interplay of Environmental and Economic Systems. *Journal of Cleaner Production* 114: 11-32.
- Geng, Y., Sarkis, J. and Ulgiati, S. (2016). “Sustainability, Wellbeing, and the Circular Economy in China and Worldwide.” *Science* 6278:73-76.
- Golinska, P. (2014). *Logistics Operations, Supply Chain Management, and Sustainability*. Cham (CH): Springer.
- Green Deal. (2016). “Aanpak” and “GD 203: Het Nieuwe Draaien.” Last accessed October 26, 2017 at <http://www.greendeals.nl>.

- Greening, L. A., Greene, D. L., and Difiglio, C. (2000). Energy efficiency and consumption—The rebound effect—A survey. *Energy Policy*, 28, 389–401.
- Huckle, J. (2012). Even more sense and sustainability. *Environmental Education Research*, 18(6): 845–858.
- Isenhour, C. (2015). Sustainable Consumption and Its Discontents. In *Sustainability: Key issues*. H. Kopnina and E. Shoreman-Ouimet, eds. New York: Routledge.
- Jackson, T., & Senker, P. (2011). Prosperity without Growth: Economics for a finite planet. *Energy & Environment*, 22(7), 1013–1016.
- Kopnina, H. (2012). Education for Sustainable Development (ESD): The turn away from ‘environment’ in environmental education? *Environmental Education Research*, 18, 699–717.
- Kopnina, H. (2013). An Exploratory Case Study of Dutch Children’s Attitudes towards Consumption: Implications for Environmental Education. *Journal of Environmental Education*, 44, 128–144.
- Kopnina, H. (2014). Future Scenarios and Environmental Education. *The Journal of Environmental Education*, 45(4): 217–231.
- Kopnina, H. (2015a). Sustainability in Environmental Education: New Strategic Thinking. *Environment, Development, and Sustainability*, 17(5): 987–1002.
- Kopnina, H. (2015b). Neoliberalism, pluralism and environmental education: The call for radical re-orientation. *Environmental Development*, 15, 120–130.
- Kopnina, H. (2016a). ‘Energy Policy in the European Union: Renewable energy and the risks of subversion.’ *Governance and Security Issues of the European Union: Challenges for the Future*. Ed. by De Zwaan, J., Lak, M. and Makinwa, A., Williams, P. TMS Asser Press/Springer. Pp.167–184.
- Kopnina, H. (2016b). Animal cards, supermarket stunts and World Wide Fund for Nature: Exploring the educational value of a business-ENGO partnership for sustainable consumption. *Journal of Consumer Culture*, 16(3): 926–947.
- Kopnina, H. (2017). ‘Sustainability: New Strategic Thinking for Business’. *Environment, Development, and Sustainability*, 19(1): 27–43.
- Kopnina, H. (in print). ‘Teaching Sustainable Development Goals in The Netherlands: a critical approach.’ Special Issue: Environmental and Sustainability Education in the BENELUX region’. *Environmental Education Research*. <http://www.tandfonline.com/doi/full/10.1080/13504622.2017.1303819>
- Kopnina, H. and Blewitt, J. (2014). *Sustainable Business: Key issues*. Routledge Earthscan, New York.
- Lieder, M., and Rashid, A. (2016). Towards circular economy implementation: a comprehensive review in the context of the manufacturing industry. *Journal of Cleaner Production*, 115:36–51.

- McDonough, W. & Braungart, M. (2002). *Cradle to Cradle: Remaking the way we make things*. New York, NY: North Point Press.
- Mont, O. K. (2002). Clarifying the concept of product–service system. *Journal of Cleaner Production*, 10(3), 237-245.
- Murray, A., K. Skene, and K. Haynes. 2017. The Circular economy: An interdisciplinary exploration of the concept and application in a global context. *Journal of Business Ethics* 140(3): 369– 380.<sup>[1]</sup><sub>[SEP]</sub>
- O'Neill, D. W. (2012). Measuring progress in the degrowth transition to a steady state economy. *Ecological Economics*, 84, 221-231.
- Rammelt, C., & Crisp, P. (2014) A systems and thermodynamics perspective on technology in the circular economy. *Real-world economics review*, 68, 25-40.
- Rees, W. (2010). What’s blocking sustainability? Human nature, cognition, and denial. *Sustainability: Science, Practice, & Policy* 6(2):13-25.
- Sadras, V. O., Grossini, P., and P. Steduto. (n.d.) ‘Status of Water Use: Efficiency of Main Crops.’ SOLAW Background Report – TR07.
- Stahel, W. R., & Reday, G. (1976). The potential for substituting manpower for energy, report to the Commission of the European Communities. Available via [http://cordis.europa.eu/publication/rcn/1989119069800\\_en.html](http://cordis.europa.eu/publication/rcn/1989119069800_en.html)
- Stahel, W. R. (2016). “The circular economy.” *Nature* 531, no. 7595: 435.
- Stahel, W. R. (1997). The functional economy: cultural and organizational change. *The Industrial green game: implications for environmental design and management*, National Academy of Engineering, Washington, DC. 91-100.
- 
- Stegeman, H. (2015). From circular materials cycles to a circular macroeconomy with scenarios for the Netherlands. <https://economics.rabobank.com/publications/2015/july/the-potential-of-the-circular-economy/>
- Terry, B. (2011). “The Truth About Pepsi’s New Plant-Based PET Plastic Bottle.” Last accessed October 26, 2017, at <http://myplasticfreelife.com/2011/04/the-truth-about-pepsis-new-plant-based-pet-plastic-bottle/>.
- Tukker, A., & Tischner, U. (Eds.). (2017). *New business for old Europe: product-service development, competitiveness, and sustainability*. New York: Routledge.
- Vogtlander, J. G., Scheepens, A. E., Bocken, N. M., & Peck, D. (2017). Combined analyses of costs, market value and eco-costs in circular business models: eco-efficient value creation in remanufacturing. *Journal of Remanufacturing*, 7(1), 1-17.
- 
- Washington, H. (2015). *Demystifying Sustainability: Towards Real Solutions*. London, Routledge.

- Webster, K. (2007). Hidden Sources: Understanding Natural Systems is the Key to an Evolving and Aspirational ESD. *Journal of Education for Sustainable Development*, 1, 37 – 43.
- York, S. (2017). Confronting Our Global Growth Obsession. <http://mahb.stanford.edu/blog/global-growth-obsession/>
- Yuan, Z., Bi, J., and Moriguchi, Y. (2006). The Circular Economy: A New Development Strategy in China. *Journal of Industrial Ecology*, 10 (2): 4-8.
- Zorpas, A. A. (2016). Sustainable waste management through end-of-waste criteria development. *Environmental Science and Pollution Research*, 23(8), 7376-7389.