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Teaching about Sustainable Production and Consumption

Helen Kopnina

Abstract: Sustainable consumption is interlinked with sustainable production. This chapter will introduce the closed-loop production, the circular economy, the steady state economy, and Cradle to Cradle (C2C) models of 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) program at three Universities of Applied Science (vocational schools), and at Leiden University College in The Netherlands will be discussed. Student teams from these schools were given the assignment to make a business plan for a selected sponsor company in order to advise them how to make a transition from a linear to circular economy model. 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. The former mismatch is explained by the fact that the sponsor companies have experienced a number of practical constraints when confronted with the need for the radical overhaul of established practices within the entire supply chain and students have rarely considered the financial viability of the "ideal scenarios" of linear-circular transitions. The latter mismatch applies to what students had learned

about macro-economic theory and the application through micro-economic scenarios in small companies.

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Education for sustainable development and the concept of sustainability

In the context of the re-evaluation of environmental education (EE) and education for sustainable development (ESD) at the close of the Decade of Education for Sustainable Development (DESD 2005–2014), sustainability has become a major issue (Huckle and Wals 2015). Corporate, political, and citizens' powers to transform current patterns of production, consumption, and distribution are crucial in order to achieve greater environmental as well as social justice, and education remains the main vehicle of transferring knowledge and skills to achieve this transformation. Education for and about sustainability tends to involve competencies that enable students to develop their knowledge of sustainable production strategies as well as knowledge about the consequences of their consumption choices (Andersson and Öhman 2016). The mainstream sustainability models, summarized by, among others, Haydn Washington (2015), tend to focus on eco-efficiency and minimizing environmental damage, failing to address the feasibility of long-term sustainability. The damage is simply minimized or negative effects delayed rather than root causes of unsustainability eliminated (McDonough and Braungart 2002).

According to the critics of the so-called “triple P” conventional model (i.e. people, profit, planet), it is questionable whether the objective of balancing social, economic and environmental triad is feasible in the first place, since human equality and prosperity can hardly be achieved with the present rate of population growth and natural degradation (Rees 2009). In fact, the stated goal of maintaining economic growth, re-distributing of wealth while simultaneously keeping the health of the ecosystems intact appears to be naïve, misleading and oxymoronic (Rees 2010). The promotion of economic development in the quest for ecological modernization (the idea that environmental and social conditions will improve when wealth and technology further develop) may have caused more harm than good in promoting a system of production and consumption that is essentially unsustainable (Washington 2015). John Foster (2012) has noted that the current

modules of sustainability that try to address issues as diverse as global climate change and the loss of biodiversity have simply failed, and the sense of optimism that is shared by many proponents of sustainable development in general, and ESD in particular, give little more than false hope. Without systematic and radical reform of the present growth paradigm and the models of current capitalist neoliberalism, sustainability becomes all but impossible (Foster 2012).

This implies that sustainable lifestyles promoted throughout the DESD that encourage young people to reflect on their personal consumption behaviors, assumptions, and experiences, need to include meaningful ways in which sustainability frameworks can be evaluated. These ways should enable students to “analyze global and personal patterns, causes and impacts of consumption and to unfold the ethical dimension of reducing the social and ecological impacts of human productive activities at global and local levels” (Heiss and Marras 2009, p.182 in Huckle and Wals 2015).

One of the problems of unsustainability is waste. According to Girling (2011), most of the raw materials used in manufacturing are already lost before finished products leave the factory and about 80% of sold products are thrown away by consumers within the first half year of their lives. While the idea of ‘sustainable consumption’ seems appealing, without the possibility of decoupling economic growth from resource consumption, the idea of sustainable consumption is often questioned (Kopnina 2016), not the least because of the so-called rebound effect or “Jevon’s Paradox” (Greening, Greene and Difiglio 2000). The rebound effect refers to the effect of technological improvements on actually stimulating more consumption. Since production is related to consumption, one of the associated risks of subversion includes stimulating of consumption of “green” products, rather than an absolute reduction in consumption. The contemporary emphasis on “green consumerism” might also be driving more guilt-free consumption while the larger problems of sustainability remain unsolved (Zizek 2010; Kopnina

and Blewitt 2014). In the case of energy efficiency, it was demonstrated that savings associated with efficiency gains are reallocated to increased consumption (Isenhour 2015). Most of the so-called sustainable products are still produced in a linear system in which products are made of raw materials, used, and discarded. This “cradle to grave” process that, despite good intentions targeted at “eco-efficiency” (doing more with less) was criticized for leaving the existing industrial growth-based destructive system intact (McDonough and Braungart 2002).

Thus, the approach of sufficiency that limits what is produced or consumed in absolute terms was proposed (Figge, Young and Barkemeyer 2014). Sufficiency exemplifies alternative to conventional eco-efficiency models of sustainability, such as the steady-state economy (Daly 1991), Cradle to Cradle (C2C) (McDonough and Braungart 2002), and the circular economy (Webster 2007). The steady state economy is based on a steady sustainable population and a minimized throughput of resources (Dietz and O'Neill 2013). Yet, research on perceptions of circular or closed loop production and consumption in young people in education is usually limited to studies that discuss the conventional models of sustainable consumption (Huckle 2012; Kopnina 2013).

The circular frameworks are often discussed as hopeful alternatives to the “mainstream” sustainability approaches, emerging from industrial symbiosis or industrial ecology. The American architect William McDonough and the German chemist Michael Braungart (McDonough and Braungart 2002) have argued that a new post-industrial revolution is needed to reverse unintended negative effects of industrialization. This revolution should ideally develop the types of products that stay in the “loop” – without materials that need to be thrown away. C2C framework (McDonough and Braungart 2002) proposes a radical re-evaluation of the methods of production and the re-orientation toward a goal of an unproductive-waste-free system that equates waste to food.

Addressing this goal, an educational charity, the Ellen MacArthur Foundation promotes debate and discussion around the possibilities inherent in just one of these models: a transition from today's predominately linear economy to a circular economy (Webster 2012). Ellen MacArthur Foundation encourages re-thinking of business models in relation to product design as well as forward and reverse supply chains in order to reach and maintain operational efficiency (Lieder and Rashid 2016). In practical terms, this implies that the products need to be designed in such a way that the entire supply chain, from raw materials to waste, becomes "circular". This also requires economically feasible value recovery activities as part of efficient closed-loop supply chains (Lieder and Rashid 2016).

The circular economy models are not without limitations as they can be used to justify further "business-as-usual" growth without much attention to intrinsic value of environment, perpetuated in normative business education (Kopnina 2014a, b, c, d, e, f, g, f) and in wider societal contexts (Washington 2015). The 'pioneers' of the circular economy or C2C have sometimes profited from setting up certification systems, limiting the global applicability of their concepts, or sometimes cooperating with companies that are not strictly adhering to these frameworks (Brennan, Tennant and Blomsma 2015). Ellen MacArthur Foundation sees the circular economy, as advertised on its website, as a "new engine of growth".

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.

Contesting Sustainability Frameworks

The circular economy model emphasizes the role of diversity as a characteristic of resilient and productive systems (Brennan, Tennant and Blomsma 2015). Translated into business practice, this involves the private sector in seizing business opportunities within manufacturing based on a system of product loops consisting of reuse and repair activities (Lieder and Rashid 2016).

Based on these insights, the idea of circular economy was propelled forward by reports by the Ellen MacArthur Foundation and other initiatives stimulated by both government and business stakeholders (Brennan, Tennant and Blomsma 2015). The circular approaches are basically critical of conventional approaches to sustainability which seek to reduce rather than eliminate damage. Even the well-intentioned practices such as recycling, lead to mostly down-cycling, where materials are reused to make products of lower quality, which require energy to be actually given new (and lesser) life. As the authors of C2C reflected, a bad thing should not be efficient. Eco-efficiency, as in the case of “saving electricity” the authors argue, will only prolong the essentially unsustainable system, in which electricity, for electric cars for example, still comes from fossil fuels (McDonough and Braungart 2002). Rather than downcycling (converting valuable products into low-value raw materials), upcycling (converting low-value materials into high-value products) was proposed.

The “waste=food” principle is well illustrated by the metaphor of the cherry tree, with its berries and leaves that serve as food for other species and for the formation of the soil (McDonough and Braungart 2002). C2C proposes that only biodegradable materials, such as organic materials and non-compostable materials that can be infinitely re-used should be used. This way, a product can be disassembled and the two kinds of materials can be either used for fertilization or for ‘within-the-loop’ manufacturing processes that do not require virgin materials.

Inspired by such frameworks, some companies have noted that closed loops model corresponds with business sense through its potentially immense savings.

Examples of such products are not hard to find, as they were present in all pre-industrial production systems, from buildings made of local materials to biodegradable textiles and clay cooking pots (Kopnina and Blewitt 2014). It can be argued that it is time to go back to the circular systems our ancestors understood. Experience with sustainable companies shows that with smart marketing one can sell old ideas as new.

This does not mean that producers and consumers should revert back to a pre-industrial lifestyle, or that producer will be selling “back-to-the-cave” products. Innovative strategies involve the use of the increasingly advanced capacity of solar and wind power energy, the use of transport that ranges from wind-energy powered public transport to solar airplanes, such as Solar Impulse.

The Risks of Subversion

One of the weaknesses of the circular systems is that a product in use for longer (and thus rejecting built-in obsolescence which prompts consumers to keep on buying new products). This implies that direct sales of new products decrease, impacting on-going profits that could otherwise be made (Brennan, Tennant and Blomsma 2015). As Herman Daly (1996) and Haydn Washington (2015) have pointed out, since the economy lives by importing raw materials and exporting waste, economic growth is simply incompatible with ecological sustainability and social equality, as demonstrated by growing empirical evidence ranging from the failure of climate change mitigation (also by developed countries) to persistent economic disparities. The key to solving this conundrum is of the steady state economy with a fixed population and a constant sustainable throughput of resources.

Critical observers have noted that companies that get certified as C2C or good practice examples on the Circular economy are far from realizing the necessity of decoupling resource consumption from economic growth as many innovative designs still strive towards maximizing the latter and making a profit. For example, some of the case studies listed on the Ellen MacArthur website are not very ‘circular’, other than in changing some minimal elements within the overall linear model. One of the companies listed is Autocraft Drivetrain Solutions, which provides remanufactured diesel and petrol engines, transmissions and machined components to the automotive industry. Autocraft offers a full remanufacturing solution including core collection and storage, strip down, and identification and supply of replacement parts. Yet, other than attempting to recover components for the automotive industry, Autocraft’s ultimate goal is expanding into other types of components as a path for further growth, as stated on the website of Ellen MacArthur Foundation. A similar case is described by another listed case study: the Coca-Cola company that seeks to increase the recyclability of its bottles. As one of the case studies below will demonstrate, obviously, recyclability is a far cry from upcycling, and neither does Coca Cola offer any other ‘circular’ process and product transitions. As the case study below will illustrate, circular economy and C2C can also be co-opted to justify business as usual models.

The Case Studies at vocational schools

This case study is based on the minor Circular Economy in the Cloud, an experimental online course piloted by Universities of Applied Science (vocational schools) in Rotterdam, Utrecht, and The Hague International Business Management Studies (IBMS) departments. The course started in September 2014 by the Rotterdam Business School and the author of this chapter was in a position of tutor/assessor. The program was used as a trial for introducing the online course on the circular economy on a European level. The intention of examining this case study was to use

the experience from teaching this course, and evaluating results to recommend if successful and improve if needed, the theoretical content used for preparing students for distinguishing between linear and circular models.

The main objective of this course on the circular economy, given between September 2014 and February 2015, was to teach students what circular economy is and how Small and Medium-size Enterprises (SME's) could make the transition from a linear business model to a circular economy business model. 68 students were initially enrolled in the minor). The author of this chapter has supervised 2 out of 17 original teams of students – 4 students in one group, 5 in another group.

The minor had a strong practical component, with knowledge and experience sharing through the cloud (the online platform) being key to the quality of the student deliverables. Of the international students, the majority was Dutch, followed by European, South American, and Chinese students in their second and third year of study. Most of the students were between 21 and 24 years old, evenly divided between males and females. All students had a background in international business, marketing, finance, and branding.

The students were supposed to improve the ability to combine knowledge, skills, and attitude to show expected behavior when performing a professional task in an international business context. 17 SME's were selected on the basis of their general agreement and interest to participate and students could subscribe to work with a company. SME's were willing to participate because they expected to benefit from the practical solutions the teams were supposed to offer. Teams of up to five students were formed.

It was assumed by students and lecturers that the companies would benefit from keeping up-to-date with the most effective techniques like in procurement and inbound logistics concerning the circular economy. The intention was that companies develop the closed-loop

production technologies or tools for enabling circularity of production processes that will give them a competitive advantage over “linear” competitors. Overall, the aim of the assignment was to critically consider the aspects of added value to product/service containing circular economy aspects.

Description of Companies

The two teams that the author has supervised involved a project with a company that made bridges (“Bridges”) and a company that is specialized in renting camping equipment (“Tents”).

Bridges were founded in 2012, located in facilities provided by the Technical University of Delft. Bridges is separated into three departments: Engineering; Research and Development/Innovation; and Products (bridges and pipes). The student group worked with the Products division. The bridges are manufactured from steel, plastic, resins, and fiber, which are provided from two main suppliers. These bridges have the following advantages over regular wooden bridges: “Expected lifetime of hundred years, no maintenance required, easy to implement, and zero erosion from nature” (Company website is anonymous).

Additionally, to prepare 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. The company found out that there is a demand for 500 bridges to be replaced annually in the Netherlands. Apart from the conventional wooden bridge manufacturer, 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 to other European countries.

Tents specialize in tents delivered to festivals and partners with Sita, Europe’s second largest waste management company. By recycling the materials that are left behind and

redesigning the tents by using fewer materials, 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. In the initial meeting with the students, reported in the initial student report, the company claimed that the tents are made from 100% recycled film that is also used in agriculture. This was referred to it as “ag plastic” and Plasticulture, with the application of this type of film found in many products from nursery pots to crop row-covering material. Through a deposit scheme, Tents tried to encourage the user to return the tents to them. The tents were either recycled and rented out again or returned to the materials’ supplier (from the company’s website, as well as from initial interview with the students, it was not clear who the supplier was or what would happen to the tents after they were returned to the supplier).

In the consequent meetings with the company director, the students have reported to the researcher/instructor that the supplier was “probably based in China”. The company’s director has admitted in the conversation with the instructor that the current model of Tents is far from the idea of “upcycling” or being a complete circular economy operation, but the Tents is willing to consider a change for the better.

Besides the aim of students to advise the company to transit from a linear to a circular model of production, the company was particularly interested in expanding its market to the United Kingdom. According to guidelines given to students, the plan needed to contain an outline of the number of festivals, attendees, turnover, margins, archetypes of the UK-festival market, a list with possible partners and analysis of the competition.

Findings from case studies Tents and Bridges

Tents

Students analyzed the current inbound/outbound logistics, documentation provided by the company, noting that the current products are bought from Asian suppliers. The supplies need to be transported to the production sites and from there to the Netherlands to be transported to the targeted locations at the festivals or the homes of the clients. The students noted that the problem with the current way that the products are produced and transported is the high costs and CO2 emissions.

Students emphasized in their written report that there are several ways to improve the current inbound/outbound logistics. Proposed improvements with the inbound logistics included production at local sites, finding local suppliers and revising shipping to other places than the festivals for outbound logistics. If Tents could be available at the camping sites of festivals, this would create the desired result: people coming to festivals by public transport. Another way to promote this could include giving a discount when a public transport ticket is shown. The students suggested that the delivery method can be improved by combining delivery with other cargo or delivering products by public transport. Ideally, the tents could be stored on the campsite.

To lower associated costs, the group suggested that customers could rent the tents. In this way, each tent can be reused several times, so fewer tents have to be produced. The students wrote in their report: “when a tent is damaged the customer will not be able to get back their fee and when an inner tent is dirty it can be replaced, washed or reused in another way.” Yet, the students noted, this means that the current business model needs to be changed.

As for the use of resources, the students have noted that recyclable plastics and cotton fiber mass were produced in China. The students have contemplated the use of materials that could extend the longevity of the tents to make them more suitable for refurbishing, transforming the used tents into parts for a new one, using a repair kit for the current tents. While the main

business was renting airbeds, tents and sleeping bags, it could be supported by additional services, such as cleaning, repairing and, if needed, replacing inner tents.

Bridges

Reporting on the feasibility of transition to the types of material that could remain in a closed-loop system 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 provide the client with an analysis that portrayed the company as sustainable. 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 final report focusing on desk research about materials used for bridges, students distinguished synthetic fibers, the raw materials used to create synthetic fibers, such as raw petroleum (carbon), silica (glass), and basalt (ceramic) and natural fibers found in plants. These include cellulose fibers, animal (protein) fibers and minerals (such as asbestos, which is now banned due to its carcinogenic qualities). As the student teams have found out in the desk research section of their report, most natural fibers have different specifications and functions that highly depend on the environment in which the plant grows. In an evaluative interview with the instructor, the students reflected that most of these materials can be infinitely reused rather than recycled after the productive life of the bridge has ended.

However, it appeared that these suggestions would require an overhaul of the existing business model. According to the evaluative interview with the team after completion of the project, 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.

The group pitched a proposal to their sponsors (both university and company) after four weeks. While students recommended that the company address their competitive disadvantage as a “circular economy company”, recommendations towards a circular economy approach were incomplete. The student report, while distinguishing theoretically between circular and linear processes, has ended in a vague recommendation that the “Bridges” needs to keep on working towards circularity. In the oral evaluation with the students, it appeared that this vagueness was due to the fact that the students began to doubt the feasibility of the transition, as well as the company’s willingness to undertake the necessary steps. The obstacles to the successful implementation were the lack of management’s commitment to the project and the unwillingness of the company to change its business model.

Reflection on Student Projects

According to the documents of the DESD, the “basic vision of ESD is a world where everyone has the opportunity to benefit from education and learn the values, and lifestyles required for a sustainable future and for positive societal transformation” (DESD 2014, online). In circular economy too, essential future developments for implementation require more extensive work in the area of social awareness and new business models. Indeed, “educational approaches in the

area of value management are necessary to change the prevailing perception of waste and uncover the potential of circular product systems and their competitive edge” (Lieder and Rashid 2016, p. 13).

In order to learn about sustainable lifestyles, particularly in relation to consumption and production, the students needed to learn alternative production models, as well as overcome a number of practical challenges. One of the most crucial challenges to achieving the transition from linear to the circular model requires “economically feasible value recovery activities as part of efficient closed-loop supply chains” (Lieder and Rashid 2016, p. 13). The economic feasibility of such transition was undermined by the reality of financial constraints described by the sponsor companies.

Since the students in some cases were refused information about materials used or about the whole supply chain or parts of it, it appears that the learning exercise described here was largely unsuccessful. There appears to be a degree of mismatch between expectations of the company and the students on the one hand, and mismatch between theory and practice on the other hand in the sample of companies that the student teams approached.

These mismatches had to do with a number of factors, including the recruitment method, in which the companies were not explicitly informed about the circular economy models nor appeared to have a clear understanding of what these models entail. Rather, the “business as usual” qualities 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 and even appearing to want to go further.

Second, sponsor companies have realized half-way through the project that transition towards a radically different business model was impractical, expensive, or altogether impossible given financial constraints. 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.

Thus, the sponsor companies experienced practical constraints when confronted with the need for the radical overhaul of established practices within the entire supply chain and the question of financial viability of the “ideal scenarios” of linear-circular transitions. In their oral evaluation of their experience, the students have reported that they started doubting the feasibility of such a transition for companies either within outdoor equipment and rental service, and urban infrastructure industries. As one of the students from the Tents company has reflected in an evaluative interview with the researcher: “We thought we could just... suggest change and they [the company] will do it... We didn’t know they didn’t have money... [or] how much exactly they need to invest to change their... [supply] raw materials... I am not sure it is always possible... that company can afford to change... even if they want to”.

Another mismatch observed was between what students learned in macro-economic theory and the application through micro-economic scenarios in small companies. 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 production. As a result, the students were disappointed with their results.

Yet it is important not to throw a baby out with the bathwater. When considering Cradle to Cradle and circular economy, it is important to distinguish between what is feasible and realistic and what is ideal. In the context of this case study, it did not appear that the students made a meaningful contribution to the companies, or that the companies were willing or able to make the transition. However, the students did gain critical learning experience, and the

companies reportedly did consider the possibility of change in their current business model (Kopnina 2016a).

Case studies at Leiden University College

The author was also involved in the instruction of students of the advanced course Environment and Development (E&D), the elective advanced course at Leiden University College (LUC). For the course period reported here, from August to October 2016, the sample consisted of students with ages varying from 22 to 24, with 10 males and 11 females. In E&D there were 21 participating students. One of the many aims of the course was to encourage the teams of 4 students to come up with suggestions for Cradle to Cradle or circular economy products based on the largely theoretical study of different frameworks of sustainability (for a detailed description of the course see Kopnina in print).

One of the negative examples students have found was posted on Ellen MacArthur's Foundation website by Coca-Cola Enterprise (CCE). Using the case study *Coca-Cola Enterprises; increasing post-consumer plastic content in packaging*, the student wrote, “we are able to recognize a case of greenwashing”. Coca Cola states that it is “committed to maximizing the usage and value of the plastic used in bottle production”, whereby they decided to invest in Continuum Recycling, a plastic reprocessing facility.¹ The case study states that at each stage of the packaging sector, CCE is trying to improve the overall recyclability of their product, reduce the number of materials they use and use more renewable content in order to maximize the usage

¹ Coca-Cola Enterprises; increasing post-consumer plastic content in packaging. (n.d.). Retrieved October 23, 2016, from <https://www.ellenmacarthurfoundation.org/case-studies/increasing-post-consumer-plastic-content-in-packaging>

and value of the plastics used in bottle production.² The following diagram (Figure 1) is given to show the cycle of their bottles and how they are aiming towards a circular economy.

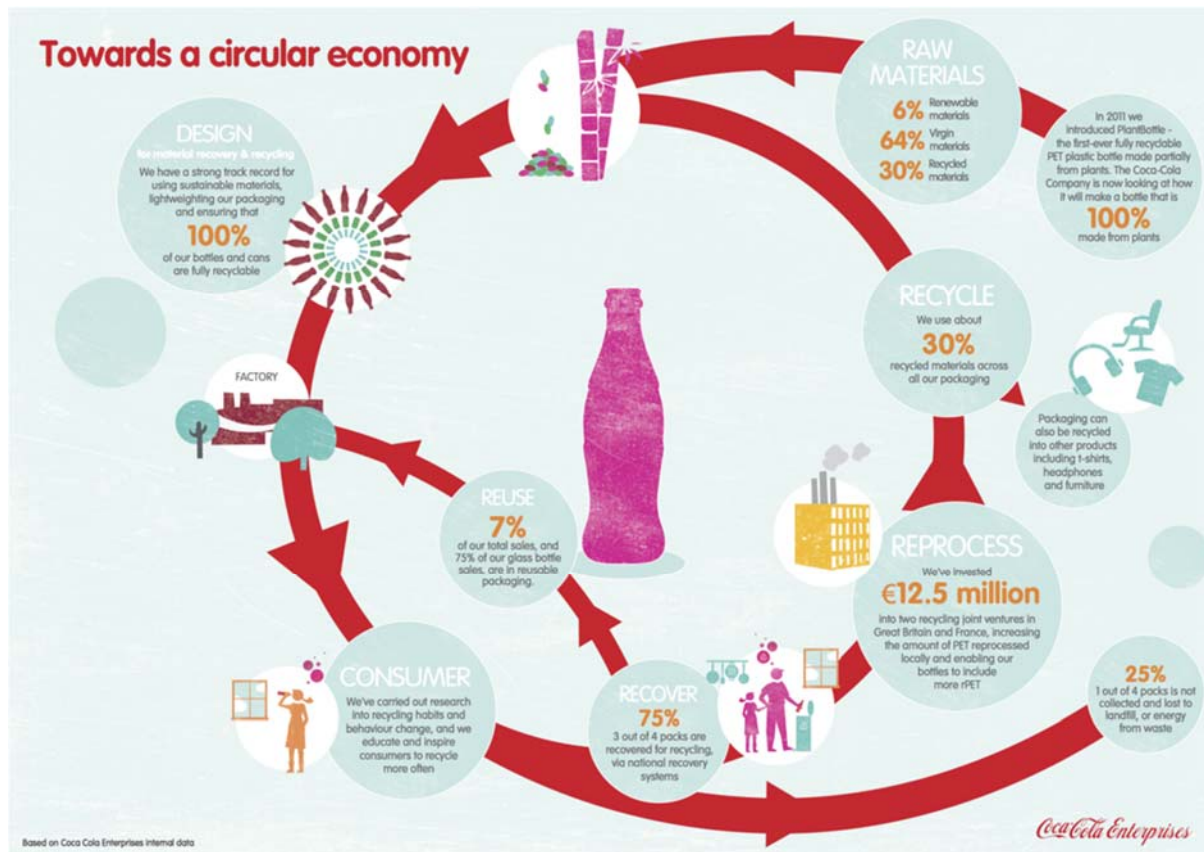


Figure 1: Towards a circular economy, the Coca-Cola Bottle³ (adapted by a student)

The student has noted that in CCE advertisement, CCE uses 6% of renewable materials, 64% of virgin materials and 30% of recycled materials in their bottle production. Initially, the large percentage of virgin materials, defined as "resources extracted from nature in their raw form", used in its plastic bottles seems like they are becoming more environmentally friendly as they are

² Coca-Cola Enterprises; increasing post-consumer plastic content in packaging. (n.d.). Retrieved October 23, 2016

³ Coca-Cola Enterprises; increasing post-consumer plastic content in packaging. (n.d.). Retrieved October 23, 2016

100% recyclable although not biodegradable or compostable.⁴ However, these virgin materials include sugar cane juice and/or molasses, whereby a case of upcycling can be identified as CCE is converting low-value materials into high-value products that become more desirable to consumers. However, this means that large amounts of these virgin materials need to be extracted in order to keep up with the high volume of production. Whereby CCE neglects to mention where they extract these goods from, the amount they use, its shipping CO₂ emission, the resources needed to extract these natural resources and delivering them to their factories as these consist of endless amounts of pollution and harm to the environment that the new bottles don't fully compensate for. However, Coca-Cola made the announcement that they hope to use 40% of PET or renewable plastics by 2020, instead of virgin goods and only 30% recycled materials.⁵ Given this, the student reflected, the company is only promoting that they are becoming "green" in one aspect of their product life cycle; their plastic bottles usage.

The students have also reflected in more positive cases. Exposure of the students to literature from the fields of industrial ecology and ecological economics has inspired one team of students' ideas to look into the case of ecological or "green fabric". One of the teams selected a company that has incorporated the "waste = food" principle in fabric design, branded Climatex, resulting in the fully biodegradable quality fabric which was awarded Gold-level C2C Certification (<http://www.c2ccertified.org/innovation-stories/designtex>). Remarkably for normally protective profit-oriented business models, Climatex stresses the importance of transparency of its production and in fact, encourages others to imitate its innovation to

⁴ Virgin Materials. (n.d.). Retrieved October 23, 2016, from http://www.caslab.com/Virgin_Materials_Meaning/ and What Is the Coca-Cola PlantBottle? (n.d.). Retrieved October 23, 2016, from <http://www.hpcorporategroup.com/what-is-the-coca-cola-plantbottle.html>

⁵ Coca Cola Enterprises to reduce virgin plastic use. (2015, June 10). Retrieved October 23, 2016, from <http://www.letsrecycle.com/news/latest-news/coca-cola-enterprises-to-reduce-virgin-plastic-use/>

contribute to the economies of scale (<http://www.iehn.org/publications.case.rohner.php>). This potentially can make the fabric not just widely available but also affordable for various industries ranging from interior design, healthcare, automotive, transportation, clothing, and shoes. The group has commented that this product has inspired them to think that if such material can be produced on a large scale, this could signify a significant transformation (see Figure 2).



Figure 2. Climatex (adapted by a student)

Another group made a presentation about Bakey's Foods Private Limited edible spoons and other utensils, made of water, sorghum flour, rice flour, and wheat flour, without preservatives and pesticides (<http://www.bakeys.com/>). The company was established in 2010 in Hyderabad, Andhra Pradesh, India as an alternative to disposable plastic/wood cutlery and

bamboo chopsticks. The cutlery was intended for developing countries as these have the greatest amounts of plastic waste and pollution. The spoons have an 18-24 months shelf life and are biodegradable. On the surface of it, the product appeared Cradle to Cradle as one can literally eat one's waste and one uses 'solar income' for plant matter. Celebrating diversity can be related to counteracting monoculture of rice, and the product design is both innovative and traditional (see Figure 3).

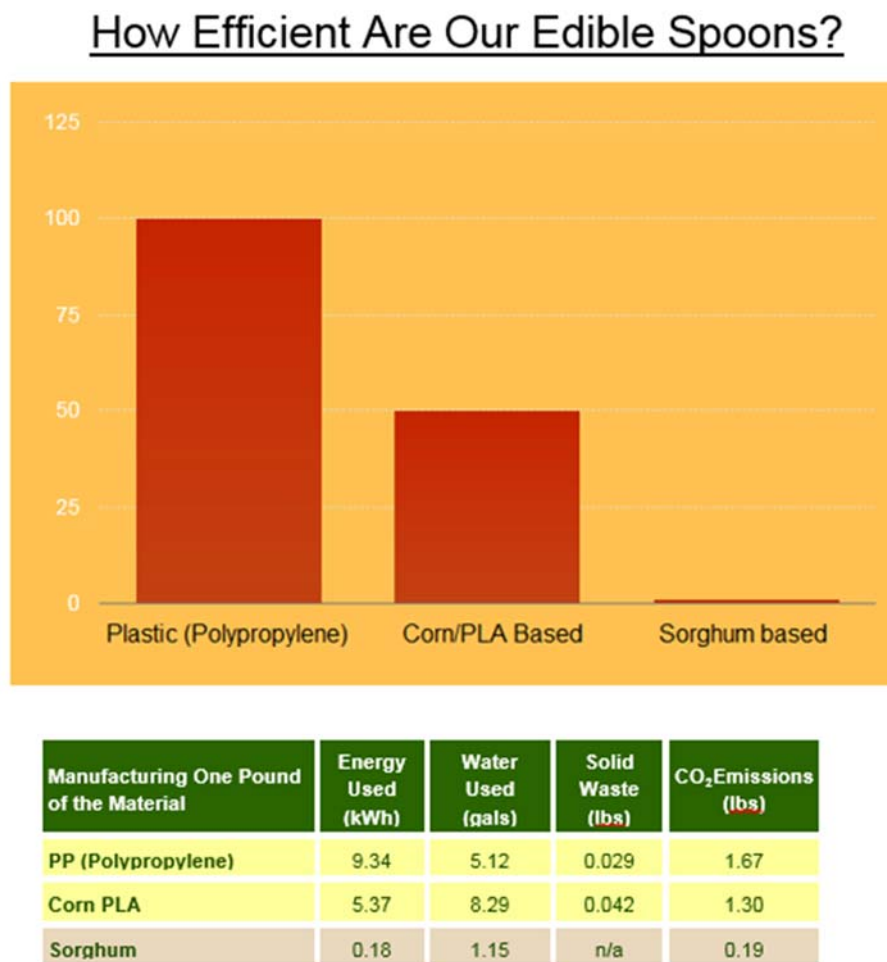


Figure 3. Bakey's spoons (graph made by students)

The group has noted a few features that have made this product less Cradle to Cradle. Spoons were sold in plastic wraps. From the information the group could gather it was unclear

where the energy used for production come from and it was not clear exactly does the factory in India functioned. The transport used for distributing the small orders of cutlery was also noted as problematic. Business challenges included the fact that edible spoons were two times more expensive than plastic spoons. While the company got funding from the crowd-funding platform Kickstarter, the funding from mostly American donors made the product too expensive for average Indian consumers, as well as too expensive to ship to America to compensate the donors. The students have thought of a number of solutions, including bigger capital that should come from investors in the target market, particularly the Indian wealthy and environmentally-aware consumers, and keeping all distribution in India to lower the cost and eliminate transportation problems. More transparency as to the way the factories are operated, and products delivered and packaged were found desirable.

Reflecting on the case studies

Generalizing from the case studies, this chapter has raised a number of questions related to ideal and feasible options for sustainable consumption and production. As Huckle and Wals (2015) have noted, in order to address sustainability challenges, we need to teach our students to link unsustainable consumption to the structures and processes that shape consumer capitalism. The examination of the economics of radical alternatives in this chapter was exemplified by production models that reach beyond conventional sustainability with its focus on reducing the damage through eco-efficiency and toward more circular or closed loop models.

In fact, more sustainable production and consumption practices may require a policy which can move us beyond consumer choices to reengage individuals in their roles as citizens, helping to effectively and fairly regulate resource use and waste production (Isenhour 2015). Such re-orientation would require the willingness of schools, sponsor companies, students, and

perhaps most importantly, “big” actors, such as governments in radical rethinking and re-evaluation of available sustainability options.

The risk of subversion applies to both production and consumption through rebound effect as well as through the continuing domination of economic growth models. Obviously, not everything that is branded ethical and sustainable is actually realistic, as far as delivery of services is concerned. Based on the brief analysis of student assignments, it can be recommended that in the teaching of the circular economy one should be aware of the pitfalls and risk of subversion of good intentions and green-washing. One way to deal with this is to embrace economic and social pragmatism and partially abandon ideal or theoretical objectives of closed loop systems. Indeed, it might be impossible to build a 100% sustainable bridge using organic fibers or to factory-produce enough edible spoons to serve the lower income consumers of an Indian market without using fossil fuels or other non-sustainable means of running the factory. A compromise between the use of acceptable, desirable, and perhaps less desirable materials might need to be made. Yet, an attempt to make products more like Climatex and less like Coca Cola – and be able to teach students why certain frameworks are more useful than others in evaluating the ‘circularity value’ – needs to be part and parcel of both research and teaching practice that attempts to address practical challenges of sustainability. This requires examination of actual products and services when linking production and consumption, with particular emphasis on a critical examination of the entire supply chain. This is helpful in evaluating the overall "sustainability value" of courses such as those presented above, as well as being able to judge some ideas for sustainable production and consumption as better than others.

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