



Inspired by Cradle to Cradle®

C2C practice in education

Cradle to Cradle is a promising concept for our common future. Enjoy this mixed collection of both business and educational cases from C2C-leading countries and get inspired by them!

Make C2C a significant part of your agenda

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With an introduction by Prof. Dr. Michael Braungart

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Celebrating human dignity

The first key aspect of Cradle to Cradle® in education is to move away from teaching children to feel guilty. We have faced a long period of all kinds of environmental disasters which has created a feeling that it would be better if we were not here. This is why people talk about minimising footprints. For education, however, that's not a very positive message.

There's no doubt that sustainability has brought us a great deal of valuable expertise such as knowledge about supply chain management, logistics, toxicity, top soil, phosphate, nutrient recovery, material flows, etc. There is a wide range of knowledge that we can now use and build on. However, this has also led to us feeling guilty for being alive and being on earth. If this is the basis for education, you will not be able to inspire people to do new things. You can't be innovative working from guilt because you're trying to minimise feeling guilty. We now have the opportunity to use 30 years of environmental debate for innovation. To put plastic into the ocean is just stupid, just like making chemicals that damage biological systems. People become more creative when they feel appreciated and live without fear. It's far more powerful to be proud of what you do.

So the first, and far most important thing is to tell children that we are happy that they are here.

I've looked at over 50 different types of native tribes and learned that when people feel accepted and safe, they are always generous and friendly. Even the poorest of the poor share their things.

I hope this book inspires teachers and educational policy makers to create more room for children and students to feel accepted and give them the opportunity to be proud of being here.

Noodle to Noodle?

There are many approaches that can be taken when teaching children about our planet. However, I would kindly like to ask you not to confuse the concepts of industrial ecology, sustainability and life cycle assessment with C2C®, because otherwise it all just becomes 'noodle to noodle'.



In my opinion, the concept of sustainability is especially unattractive for education. There is no innovation that is sustainable; otherwise it wouldn't be an innovation. Sustainability always remains within the realm of existing systems, i.e. it always stays in the same paradigm. And just so that we're clear, if we stay in the same paradigm, we will destroy the planet. Minimising your footprint, doesn't help; we need to do things differently. People have been trying to do things that are less bad for many years now, but that just delays the process. We'll just destroy the planet a little later. That doesn't make sense.

Cradle to Cradle® is about innovation, quality and beauty. It's not beautiful when it's toxic. And it's not beautiful when people can't make a living either. These young kids want to be proud of what they do. Educational institutions have all the means to make young people feel accepted so they can be kind and generous. Sustainability is guilt management from the past. Why would we want to be less bad, when instead we can be good? Instead of talking about minimising our footprint, Cradle to Cradle® is about making a big and positive footprint.

Positive intentions & goals

Education is always about intentions: Where do I want to be? What do I want to achieve? What is relevant for the people I'm working with?

And this requires long-term goals. By teaching children to set long-term positive goals, like: In 10 years we want to be soil 'positive', the educational system could make a dramatic change and generate endless innovation.

Cradle to Cradle® in education needs all your expertise

This book showcases examples of the first steps that are being taken to implement Cradle to Cradle® in education. Several institutions in the Benelux countries are looking at how to implement C2C® in their respective curricula. And there are similar developments in Denmark, Germany and Sweden as well. It's amazing how fast it's spreading.

C2C® helps empower students and teachers to become engineers, designers, architects, chemists, economists, communications specialists, managers, product developers, marketeers and urban planners because there is so much room to innovate. We need a change in education in all the different subjects. We need a whole range of skills to work together on solutions, and for that we need a whole range of qualifications. Some people are more into operating things and others more into constructing, while some are more into conceptual work and others more into applying it. To really make things work, we need C2C® principles to be applied to all fields.

I would be delighted if this book could help bridge the gap between the universities of applied sciences and the traditional universities because we need to develop solutions together. We need to combine theory with applications for finding answers to the question of how can we do this.

Cradle to Cradle® in education is about taking people as they are and supporting them to become what they want to be. This means looking at a C2C® society. It's about looking at what the human role is on this planet; it's about innovation, a positive footprint, a system that allows us to be beneficial, instead of less bad; it's about giving people a long-term goal and a positive vision of where to go. Cradle to Cradle is about a positive agenda.

To reach that goal, everybody needs to be on board. All your expertise and all your skills are essential. I hope this book invites and inspires you to look at how to translate C2C® principles to your field.

Kind regards,
Prof. Dr. Michael Braungart

Hamburg, February 2011

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While repairing the engine, the student mechanics automatically sorts the metals and other materials used, to make sure the other students have plenty of stuff to work with. Again. And again. And again.

It has been a long day and Jeanne sits down for a second while watching over her lovely smelling hand creams, moisturisers and other skin products. She had been taught to read and really understand what is on the label. And these... she knows for a fact, have only nice, healthy things in it.

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1. Introduction to Cradle to Cradle®

Ljiljana Wiersma-Rodic PhD & Douglas Mulhall,
Cradle to Cradle Chair, Erasmus University

Cradle to Cradle® is an innovation framework developed by Michael Braungart, and William McDonough and their colleagues in the 1990s for designing products and systems that are explicitly beneficial to the individuals involved as well as to the natural environment and society at large. It is based on award-winning research started in the 1980s and continuing today at the Environmental Protection Encouragement Agency (EPEA) in Hamburg Germany, for designing beneficial economic, social and environmental features into products, processes and systems.

The approach was originally known as the Intelligent Product System, and was awarded the Océ van der Grinten Prize in 1993. The approach is primarily an entrepreneurial and innovation concept that starts by determining the intended benefits of a product or service instead of focusing on minimizing negative environmental impacts.

Development and design of materials, products, production processes and entire systems are based on the principles of natural ecosystems, where the quality and effectiveness of material and energy flows are central features. Some examples of this include the development of human-

friendly buildings that produce energy and clean air, or agricultural and other activities that help to restore topsoil as one of our most valuable natural resources. Much like in natural ecosystems, material flow partnerships play a key role in the implementation of Cradle to Cradle principles.

C2C functions in three distinct but inter-related categories

Philosophy

E.g. the concept of positive intentions and being beneficial instead of 'less bad'. The concept of C2C as an innovation platform for improving quality. These philosophical approaches provide an inspirational basis that distinguishes C2C from conventional 'sustainability'. The philosophy of C2C also allows for further development of C2C as well as healthy discussion over what is the purpose of human beings on this planet, as described by Michael Braungart in his introduction.

Principles

Three basic principles that guide implementation of the C2C philosophy. The distinguishing point about these principles is that they can each be implemented measurably so that progress can be determined toward a goal.

Application Tools

The scientific, technical, economic, management and social tools that are used to implement the principles. C2C innovation starts by determining the intended value and defining one's own positive, beneficial intention. The process is then supported by a 'road map' prepared to ensure complementarity and synergy among the individual activities. An example is the ABC-X or 'traffic light' system of assessing product ingredients for their defined use.

Principles

The three basic principles of the Cradle to Cradle framework are:

- Waste = Food (everything is a nutrient for something else)
- Use current solar power income
- Celebrate diversity (biodiversity, conceptual diversity and cultural diversity).

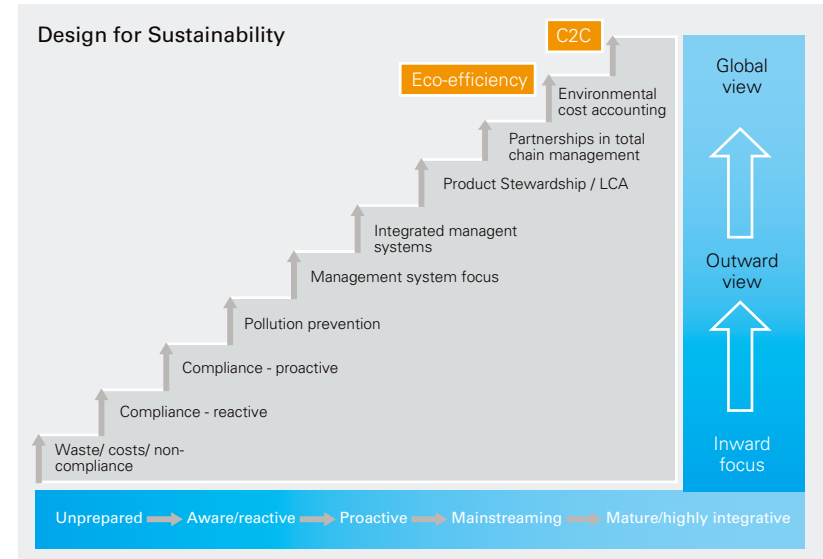
Waste = Food (everything is a nutrient for something else)

There is often a misunderstanding of this principle due to the quick and catchy but somewhat misleading title. The important thing is not that waste becomes food for something else, but instead that everything

is a nutrient for something else. This includes materials that are not normally considered to be waste.

One of the fundamental laws of nature holds that residual materials from the metabolism of one organism constitute food for another organism. In a society that is based on Cradle to Cradle principles, all materials that we consider to be waste serve as input (nutrients, food) for a new cycle of production, time and time again. In this way, Cradle to Cradle eliminates the concept of waste because waste = food. The Cradle to Cradle concept distinguishes between consumption products and service products. Consumption products either get spent (consumed) or wear out during their period of use and, if anything is left over, it can be safely returned to the natural environment. Some examples of this include agricultural products like bread and butter, cosmetic products like soap and hand cream, and natural fibre clothes and shoes. Such materials are considered to be biological nutrients, as they feed into a natural biological metabolism ('biosphere'). Biological nutrients, e.g. wood, can be used in pre-defined 'cascades', where the quality deteriorates from one application to the next, but in the end all of the material can go back into the biological cycle, in ways that are beneficial for and thus not harmful to human health or the environment. As these materials come from the land, due care is required for these nutrients to indeed remain on land instead of ending up in the ocean, where processes of biological degradation

are quite different to those of terrestrial ecosystems or a composting installation. Service products do not get consumed, but rather provide the user with a certain desired service. Some examples of this include cars, washing machines and TV sets. These products are usually made out of metals and various synthetic materials, which originate from renewable or non-renewable sources and are often hazardous to human health and the environment. As such, they cannot be safely returned to the environment if they are completely disassembled into their component materials and disposed of after special processing. Those types of processes are usually impractical or too expensive, so it makes more sense to keep the materials in technical cycles where they can be reused and do not enter the environment in concentrations that are hazardous. Moreover, they often contain rare metals that are available on earth in very limited amounts. For these reasons, they are considered technological nutrients and should be returned to the technological cycle ('techno sphere'), where they will be used to make new products with the same level of quality, time and time again. A famous example of this is Herman Miller's Mirra chair, which has been designed for disassembly and for its materials to be reused in high-quality applications at least 200 times. According to Cradle to Cradle, the worst possible designs are so-called monstrous hybrids, consisting of materials that cannot be separated after use their period of use, and thus cannot be returned safely to either of the two cycles.



Use current solar power income

The Cradle to Cradle concept assumes a reliance on renewable energy sources that ultimately originate from the sun, i.e. solar energy, wind energy, water and various innovative bio-based sources, provided that they meet requirements of the first C2C Principle, and do not compete with food crops. For further explanation of current solar income please refer to *Cradle to Cradle Criteria for the Built Environment* (Mulhall c.s., 2010) which contains an annex on C2C and Energy describing this more precisely.

Celebrate diversity

Respect for diversity in all its forms, including biodiversity, cultural diversity, and diversity of ideas and innovation to suit local conditions, is an integral part of the Cradle to Cradle concept.

Instead of relying solely on legislation as a means to reconciling the perceived conflict between economic interests and environmental protection, Cradle to Cradle encourages designers, entrepreneurs, policy-makers, material and other scientists alike to create systems and products that are beneficial and add value to all three domains: the economy, society and the environment.

Cradle to Cradle versus conventional Sustainability

In further sections of this book you will frequently see reference to 'sustainability' when interviewees are discussing C2C. This is because companies often include C2C under their 'sustainability' portfolios.

But actually this is not the ideal way to approach C2C because there are fundamental differences. Conventional sustainability usually attempts to minimize bad impacts through efficiency while C2C aims at improving beneficial ones.

To illustrate this let's consider the case of mobile phones. Produced

under sustainability principles, individual mobile phones have become far more efficient, but collectively consume many times more materials and energy than they used to, because efficiency made them affordable for billions of users. Mobile phones produced under C2C principles are designed to make sure they can be effectively recovered at the same level of quality, not to minimize materials. This is a basic difference in approach for business.

This is why C2C is often referred to as 'surpassing' or 'going beyond' sustainability.

There are many other differences between C2C and sustainability as illustrated in the scheme on page 11. It is important for readers to keep this in mind when reading this book. It is also true that some application tools used for sustainability are also used for C2C¹.

2. C2C® knowledge and education: a business perspective

2.1 Waste no more – The Van Gansewinkel Groep

Roel Majoor, Organisational Development Manager

(interviewed by Judith van Heeswijk)

The Van Gansewinkel Groep is a major player in waste management in Western Europe. It's also one of the first companies in Western Europe to fully implement Cradle to Cradle® design in its business processes. The company's sustainability ambitions have been translated into their business operations and into a strategy that includes Cradle to Cradle objectives.

From their mission statement²:

“By seeing Cradle to Cradle as a guideline, we deal with raw material shortages and the CO₂ problem. We assume opportunities and not debt management.”

The company sees waste as a source of new raw materials and energy. They see their role as one that closes the biological and

technological cycles. The constant conversion of waste into energy and raw materials is seen as added value. The company transformed from a traditional waste collector into a supplier of sustainable raw materials and energy. They seek sustainable solutions for their waste streams and consider their knowledge of waste as something of value to partners. Their goal is to work together in early product design stages so that they can fulfil a role and help deliver profitable solutions for waste streams.

Given that Van Gansewinkel has embraced the Cradle to Cradle concept, this has also had implications for its operations and the way business (waste) processes are designed and managed. This means additional knowledge and competences are needed from employees. Since 2008, the company has been working together with EPEA to streamline knowledge in operations. They found that a lot of implicit knowledge about waste management is useful for understanding the transition to C2C. There was less explicit knowledge about C2C basic



principles, so the company had to acquire additional knowledge about this. The EPEA shared these principles during a first meeting. After that, practical knowledge and experience was even more important to bring employee knowledge up to a working level. The company understands that there is a significant difference between knowing C2C in theory and predicting the way it will have to be applied in daily practice. The steps and processes have to be thought through and visualised several times to be able to thoroughly understand the principle. To really use C2C, insight into its use is essential. You have to make it your own. It is a radically different way of thinking and is, therefore, a paradigm shift. This means it also asks for a paradigm shift from employees. And in relation to customers' needs in particular it is becoming more and more practical, as it also means that you ask the customer to think about waste from another perspective. The Van Gansewinkel employee has to be able to communicate the principle to the customer. Communication is something that should not be underestimated in the transition to C2C.

Van Gansewinkel used three different training courses:

- 1 **Champions training:** A four-day EPEA training course, in which the theory is brought to life and cases are studied. This training course was developed for regional management, key account managers,

waste managers, sales and marketing managers. A total of approximately 150 people took the course. The training course focused on large industry.

- 2 **Sponsors training.** A two-day EPEA training course for employees that need to know how to translate the C2C concept into the organisation. This training course was developed for managing directors, etc.
- 3 **Advisors training:** two one-day training in company courses for sales executives. It dealt with the basic principles and translating them into business operations. The training course focused on small and medium enterprises (SMEs).



'Garbage Elephant' - © Franny Thonhauser

Large industry is able to close the biological and technological cycles itself, but that isn't the case for SMEs, which are often just a small link in the production chain. Therefore, they are more dependent on other companies to change production and waste processes. Van Gansewinkel has turned out to be a chain facilitator in some cases. Van Gansewinkel has a reason for doing so because large volumes of waste are often necessary to be economically efficient.

Competences

Van Gansewinkel states that working with C2C principles is more important than knowing them. General change management competences are essential and the three change management steps are:

- 1 To raise awareness about the need for change.
- 2 To highlight the momentum for change.
- 3 To create a willingness to change

It is only after you have taken these steps that you can work on the ability to change. The new competences for Van Gansewinkel were primarily change management ones. The main goal is to be able to address the story in a positive way, to tell it simply and convincingly, i.e. the sales pitch. Telling the story is not about selling a product, but about conveying an ideology. The employees have indicated that using the C2C concept adds more depth to their work and energises them.

Management noticed that employees invest more time and energy in their work than their role requires. This is also evident at course reunions that take place a year after the training. Everyone is very willing to attend them and a lot of passion for the concept is shared.

Technical issues

From a technical point of view, it is mainly the strength of innovation that is important for the company. The company is implementing biomimicry for its innovation processes. It starts by learning to understand processes in nature and, from there, to develop and innovate the company's processes. It's a link between biology and technology or taking the ecological system into the technological one.

Knowledge management

Knowledge management has been very important for the main issues surrounding C2C transition. Several knowledge centres were opened to gather information and knowledge on materials and processes. It is not only the operators who have access to this information, but also account managers and local waste managers. These knowledge centres also provide information on where certain knowledge on materials is available and what specifics are accessible.

Seeing as the company is moving towards a more facilitating position in the materials market, it is focusing more on logistics and purchases. New business opportunities have also arisen, e.g. it's investigating the possibility of producing and selling recycled glass for the consumer market. The glass industry is reluctant to invest though, so Van Gansewinkel has decided to develop this business on its own. This shows how innovative its new role can be.



Knowledge and education

At the moment, the company has to consult others in the new fields of expertise required. For the very first time ever, they have three technical university trainees for these fields, i.e. Geometrics; Industrial Design, and Energy Sciences and Operation Management & Logistics.

Additional knowledge on the basic Cradle to Cradle principles is needed for vocational-level competences. The basic ideology has to be embedded, so that employees are able to convey it to others. Employees on the technical site who have a vocational education background have to deal with the concept when working on separation plants. The main part of the machines in the plants is developed within the company. Technical engineers and operators are consulted during the development of new separation lines. This process actually hasn't changed since C2C has been implemented. The operators are used as part of the developing processes. Only the perspective, goals and market needs have changed.

Current developments within the organisation are expected to be temporary, because the transition to C2C is now leading the way. In the future, all the necessary changes will be made. The current change asks for a more project-oriented way of working and for employees to invest more time in it. Over time, however, products in the waste stream will be more and more assembled or degradable. The company wants to have its waste processes aligned with these products and material streams by then. At the moment, the company has to deal with different types of material streams. Over the next few years, all technical engineering education needs to focus more on design. Design principles have to be taught to higher education and academic students.

C2C principles also impact the organisation. A roadmap³ has been designed to change facilities, e.g. the vehicles, human resource management (diversity and employing senior personnel,) and to make internal processes more C2C proof. They admit that pursuing these ambitions is sometimes a bit difficult financially speaking.

2.2 Quality personnel - DESSO

Joris Bressers, Human Resource Advisor

(interviewed by Judith van Heeswijk)



Carpet, carpet tile and artificial turf manufacturer Desso is one of the leading companies in its field in Europe. Their Business Carpets division manufactures carpets for commercial locations such as offices, banks, retail units, public buildings, schools, universities, hospitals and care centres. Point 3 of DESSO's innovation strategy⁴ is its ambition regarding Cradle to Cradle:

"Cradle to Cradle: Developing products and processes that will contribute towards a better environment and better indoor quality."

Desso is the first carpet manufacturer in Europe, the Middle East and Asia to adopt the Cradle to Cradle design philosophy and they are planning further geographical expansion into Latin America. Their carpets and artificial grass will be produced using manufacturing processes that rely on renewable energy, seek to conserve water and embrace social responsibility. Their products are made from environmentally friendly, pure materials that are safe for human health and are designed in such a way that they can be biologically or technologically recycled⁵ at the end of their useful lives.

Prior to formal Cradle to Cradle certification being granted, products, materials and components must all undergo a rigorous assessment procedure. The initial stages of the certification process comprise assessing raw materials in terms of human and environmental health criteria, and evaluating the manufacturing process according to recycling potentials, energy and water use, and social responsibility. EPEA will be supplied with detailed information regarding all the materials involved in DESSO's products and processes. The future steps towards Cradle to Cradle certification are:

- List all the chemicals a product contains. All compounds are also separated into their components (the base chemicals).

- Material Safety Data Sheets are collected as well as all toxicological and eco toxicological data. EPEA evaluates all chemicals on 12 different criteria and gives an overall assessment, i.e. red, yellow or green.
- Work on phase-out plans for those chemicals that are given a red assessment. EPEA monitors these plans.
- DESSO has already launched its innovative EcoBase® carpet tile backing – enabling the world’s first Cradle to Cradle silver certification for an entire carpet tile product.

At this point in time, 90% of DESSO’s polyamide carpet tile collection is Cradle to Cradle certified.⁶



Competences

In 2007, when they started on their Cradle to Cradle journey, DESSO needed additional expertise in the company - primarily chemical expertise at the design stage. The marketing department also needed additional expertise on the basic C2C principles, in order to be able to communicate the added value of the certified products. Special technical project teams were set up to develop new machines.

The key values encouraged throughout the organisation – and required from every employee to ensure a successful Cradle to Cradle work method - are ‘ownership’, common sense, ambition and integrity. Furthermore, Desso have seen that employees are motivated and driven by being involved in this ambitious, strategic change of direction.

A large group of employees from the company - from a variety of departments and disciplines - were given a training course at EPEA and this expertise has since been transferred into the production processes. EPEA has been contributing to further increasing knowledge within the organisation. The company has found that it is one of the leaders in implementing the concept and therefore had to discover and tackle a lot of issues themselves in the early stages.

Employee commitment to the Cradle to Cradle goals is of utmost importance, along with a strong belief in the philosophy. If they see for themselves that implementing it works, and that the market responds positively, that creates great encouragement to move ahead.

DESSO created a Cradle to Cradle awareness team tasked with raising awareness on sustainable issues within the organisation, such as waste management. The company strategy places Cradle to Cradle as the top concern for every part of the organisation, and has identified their production processes as the first area to target.

2.3 Factory of the Future - Akzo Nobel

Jan Verlaan, Ideation Manager

(interviewed by Judith van Heeswijk)

AkzoNobel has extensive global experience cooperating with educational organisations both on traineeships and on projects. The impression of Jan Verlaan, Ideation manager at AkzoNobel, that universities and higher



education organisations are sometimes not up to speed with the new developments within multinationals. The students are often not fully equipped with essential frontline knowledge. Moreover the multinationals have difficulty finding new employees that can immediately take up a complicated subject like Cradle to Cradle and AkzoNobel needs these kinds of people as their ambition is to belong to the world's most sustainable multinationals.

The company seeks to attract genuinely motivated and interested students. A real compassion is essential, especially when it comes to sustainable issues. AkzoNobel took the initiative to search for those students another way. With some partners (BECO, Royal Cosun, DPI Value Centre, Search, Witteveen+Bos, and DSM), it developed a conceptual production environment based on sustainable principles, in terms of people (equity), planet (ecology) and profit (economy), for the total value chain. The aim of this virtual facility is to close the biological and technological cycles of a product and its related manufacturing as much as possible.

The critical factor in developing this virtual Factory of the Future⁷ is sustainable design, in which Cradle to Cradle principles form the foundation where possible. The facility's design showcases renewable energy, water management and active materials and transport management.

The Factory of the Future demonstrates the feasibility of a typical chemical plant designed according to a continuous loops system, i.e. a production environment based on sustainable principles for a positive footprint. All the partners realise that existing processes have to be redeveloped for sustainable development. Therefore, starting from scratch is essential. The project aims to generate an open concept for the factory, one that can be used by other companies and projects to benefit society as a whole.

The production environment will be suitable for a variety of sustainable products and production lines. The facility will be available as a training centre for users to train employees on new processes and products. The aim is to design not only a sustainable building, but also a sustainable production chain, which requires solutions at a much higher level.

The Factory of the Future project also extends into a learning community. Students have to apply for the Honours course, which they follow for six months and which can lead to a graduation project.

AkzoNobel reckons it will particularly need people from different disciplines who relate to sustainability. Production chains will become sustainable and will, therefore, change in the near future. Nonetheless, other aspects of enterprise will change. Financing structures, business

models, the legal system, policy, facility management, buildings, training, HR management, etc.; all of these will change because of the increasing orientation towards sustainability that will become explicit when Cradle to Cradle is introduced into the organisation.

They have people with chemical process and material skills and they train these people themselves. They need people from other disciplines who can look beyond the main processes and have a more interdisciplinary educational background.

2.4 C2C expolab

Roy Vercoulen, Managing Director

(interviewed by Pieterneel Boer)

What role do companies play in Cradle to Cradle education?

In my opinion, companies play a major part in the development of C2C education, especially in the way we look at Cradle to Cradle. As an economic business strategy that focuses on added value and innovation,



the role of companies, entrepreneurs and the business community is obvious.

After all, they play a major part in this, because innovation and education go hand in hand. Companies are looking for young creative people that who ask the right questions. These people can help them innovate and add value to their business. We use specific examples of real products to show students what is possible and to encourage them.

In addition, businesses are increasingly determining the focus of curricula for educational institutions. This is a good development because it creates more overlaps between theory and practice and allows students to get acquainted with theories that are closely related to day-to-day practice. Being able to have both the theoretical knowledge and the practical experience boosts innovation and product development. Finally, we want Cradle to Cradle to be an intrinsic value for students educated in the Venlo region. Given that companies are increasingly aware of issues regarding sustainability and Cradle to Cradle, there will be a growing demand for young graduates who have a Cradle to Cradle mindset and are able to really implement C2C principles in whatever sector they are working.

What should Cradle to Cradle education look like in five years' time?

In five years' time, Cradle to Cradle should be a leading principle within education and knowledge infrastructures at all levels. By then, we shouldn't still just have Cradle to Cradle courses and projects, but our entire education system should be focused on adding value and being innovative. Doing the right things in a good way and adding value should be common practice instead of the exception. We want to embed Cradle to Cradle as a basic principle in our education programmes, not just as a separate course, but as an integrated part of all lectures, curricula and study programmes. In Venlo, we are already working on the foundations, but this is what we're aiming for. Furthermore, there should be much closer relationships between educational institutions, companies and project environments so students can see, learn and experience how theory is being put in to practice.

With a content smile on her face, the student chocolatier knows, while sculpting a beautiful chocolate pie, that the chocolate she uses comes from a place where people her age can also go to school. Actually... she would like to visit the plantation her school is connected with someday.

Month 4

1	11	21	
2	12	22	
3	13	23	
4	14	24	
5	15	25	
6	16	26	
7	17	28	
8	18	29	
9	19	30	
10	20	31	

3. Cradle to Cradle® and education: basic principles

Antoine Heideveld, Agentschap NL

The Cradle to Cradle® principles outlined can have a huge influence on education. The question is, however, what that influence is. In this chapter, we will try to answer that question.

Do the good things well.

A great deal of work has already been done on optimising the existing polluting technologies, e.g. cars that use less petrol (but still use petrol), factories that pollute less (but still pollute), etc. We are trying to optimise the wrong things. Instead of doing so, we need to work on products and services that are good from the outset. Good for people, good for the environment, good for nature. Products that use resources, but that can be re-used endlessly. So we can close cycles, biologically as well as technologically.

This roughly means three things for education:

- establish a positive agenda into which students can put all their positive energy,

- learn from nature, e.g. biomimicry (including the basics of ecological thinking) and learn across sectors,
- work in a transdisciplinary way.

A positive agenda

Modern education programmes work on competences, active research, project education and so on. A question or a task is the starting point for all these forms of education, either formulated by the teacher, a company, the students themselves or others. These forms of education are closely aligned with the concept of Cradle to Cradle. The main idea of C2C is to simply ask a positive question, or to formulate a positive task. University students, for example, might be asked to investigate closing the loops in the paper industry within five years or to introduce a new traffic system that improves people's quality of life and increases the quality of nature and the environment. An important part of the positive agenda is to create positive values. The main question here is how we can contribute to the quality of our life. We tend to think in terms of 'not as bad'. What is essential for Cradle to Cradle is to create positive values, e.g. a house that generates energy. Students have to ensure they create their own positive values in the education project.

Learn from nature and learn in a cross-sectoral way

Positive innovations are all around us. Nature does it. Industries are doing it. What we need to do is learn from these positive innovations, both those arrived at in nature and those created by humans. A key aspect here is to learn from nature, also known as biomimicry.

Biomimicry provides inspiration from nature. Nature has many solutions that are initially good for the problems that we, humans, face. For example, the natural cooling of a building, was inspired by a *termite* hill. Another fine example is the traffic system used by ants, which, according to a German scientist, would be a great way of dealing with traffic jams.

For education, biomimicry means that students can look at solutions in nature as a source of inspiration for their problem-solving. Step-by-step approach to this would be:

- Formulate a main problem, or task to work on.
- Name a couple of organisms in nature that face or have faced the same problem.
- Investigate how these organisms solve these problems.
- Translate these solutions from nature to the original problem and look at how these solutions could be used by humans. Do not simply apply the same solutions, but look at the human conditions.

Work in a transdisciplinary way

Today, we live in a very complex and rapidly changing global society. This implies the need for new competences among current and future world citizens. It also means there is a need for communication between sectors and disciplines and for analysis of and insight into the relations between complex processes. To achieve this, knowledge from different disciplines is required and it has to be shared with different stakeholders. Sharing knowledge with stakeholders outside the school or university implies the need for trans disciplinaryity. Trans disciplinary education simply means involving different disciplines and involving different stakeholders (companies, NGOs, government bodies, scientific centres, etc.).



Month 5

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Month 6

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2	12	22	
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5	15	25	
6	16	26	
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4. C2C® and education: an educational perspective

Various authors

This chapter illustrates the significance of practical and valuable case studies within education. The descriptive, but very illustrative case concerning *Cradle to Cradle® in the region of Venlo: from primary education to scientific education* serves as an introduction to the subject.

Jos van der Heijden, Advisor Economic Affairs & Knowledge Infrastructure Venlo

It is important for the Venlo region that its inhabitants embrace C2C as an inherent value. This is not something that can be put into practice overnight; it is a gradual process. It is important to also invest primarily in young people because they will carry the C2C vision into the future. It is for this reason that the educational institutions in Venlo want to design an action plan to embed C2C as a basic principle into their education programmes; not just as a separate course, but as part of all lectures, curricula and study programmes. At this point in time, the organisations for secondary, senior secondary vocational and higher

professional education (VO/MBO/HBO) levels have confirmed their commitment, and a group of decision-makers has been formed that will further shape the action plan. One aspect of the action plan is to extend it to include primary and university education.

This will initially only concern educational institutions in this region. The first and most important step is to involve teachers and decision-makers in the education system and to work with them to establish the right mindset, e.g. through training programmes. We believe it is crucial to have the right mindset in order to successfully guarantee C2C in education. After all, these people must create the form and content of the education cycle. C2C: a way of life!

In addition, the educational institutions want to set up a project in which they will work closely together to connect teachers and students with all the design principles and issues regarding (the application of) C2C. One of the first project ideas is to develop eco-effective housing for campers. During the training programme, we want to determine the parameters of a systematic approach based on a growth model, i.e. where are we now, what is our goal and what steps do we need to take to reach that goal.

The main goal is to make C2C an integral part of education at all levels in the Venlo region, an important aspect of which is working together with trade and industry. Therefore, it is necessary to:

- Develop and carry out a C2C-training programme for teachers, policymakers and decision-makers in education.
- Develop and implement curricula at all teaching levels based on the principle of ongoing learning lines from primary to scientific education.
- Develop and implement at least 2 concrete projects that connect teachers and students in practice with the meaning of applying C2C.

4.1 Primary education⁸

Guus Geisen, co-founder of IRISZ⁹ and the Foundation Sustainable Learning¹⁰

Sustainability is hot – there's plenty of interest and yet many people are wondering how it's possible that we're still not doing enough to really tackle our generation's big issues. We're witness to increasing global temperatures and all its consequences. We know about the connection with the use of fossil fuels and other related factors.

Diversity in nature is disappearing and with it our ecosystem's potential. To a certain degree, we can understand how this has all happened and yet we can't do enough to change our behaviour. One aspect that contributes to our collective inability is the way our brain operates. A reptilian brain responds to sudden changes, critical changes or life-threatening situations. If change happens too gradually or is too subtle, the reptilian brain will not react. The increase in CO₂ and the global warming are changes that are too gradual to be noticed by the reptilian brain, which is why it's difficult to sound the alarm. The oil disaster in the Gulf of Mexico was dealt with immediately and across a wide scale, but it was already too late! This could have been prevented if sufficient moral sense had been employed in the use of the right materials. Moral perspectives are also easily overlooked when we work in a routine fashion. Many of the acute problems we experience globally could have been prevented if there had been sufficient balance between external attention and internal orientation.

Education is about how we can involve children in developments, in which they're also part, and for which we can develop a way of thinking that goes beyond the thinking of the past. Education has a duty that goes beyond teaching arithmetic and language. The curriculum is a means and not an end in itself. It is a tool with which

we, together with the children, can embody the development that we want to see in the world. Cradle to Cradle can make a positive contribution to developing children's awareness of dealing differently with their living environment. At 'De Duizendpoot' primary school children across all the groups worked together on raising this awareness. The examples below provide a brief account of the work done by group 8.

The children first watched the VPRO documentary 'Afval = voedsel' ('Waste = food') and then held a brainstorming session on the issues they could come up with that were connected to C2C. These ideas were collected in the 'Cradle to Cradle thought bubbles'. After swapping ideas, the children created a presentation table with all the possible relationships they could associate with the subject. After a few days, they had produced quite a collection.

The teacher talks to the children about what they would like to do to further develop the C2C subject and which of the issues the children would want to use. She also tells the children that she talked to a number of people at a get-together for companies during the Chamber of Commerce's C2C community event who were curious about what the children's thoughts were on some of their questions about C2C in business.



Some of the companies' questions included:

- How can children apply C2C ideas to their own lives? What do they need to do that and from whom?
- What does a C2C school building look like?
- What does a C2C garden look like?

The children set to work in groups of four and together come up with a subject. One group would like to design a school building because the school is already preparing to build a new school. A child from another group tells about his father (a landscape gardener) who is also involved in C2C developments. They opt to design a garden. For the duration of

the project, both groups are also going to work together on the school design in conjunction with the garden.

C2C school building, for the design of which multiple intelligences also play a role. The children work intensively on the assignment.

Design your own Cradle to Cradle project: Zen garden (Multiple Intelligences: spiritually smart)



At the Cortemich community school, the group 7 teachers prepared a project morning on C2C and its relationship with the children's potential. Using the theory behind C2C as their starting point, they made a connection between throwing away usable materials and throwing away talent.

Using the C2C framework, the children are going to look at themselves. What are your talents and how are you going to work on them so that they don't disappear? With the aid of system tools, the children go on a supervised quest for their talent. Each child will get the opportunity to deliberately reflect on their own 'being' to uncover their development potential.

The question then is: "what can I do to maintain this strength within myself and even let it grow into something more beautiful?"

The environment, the system in which children live, plays a key role in developing this potential. The children are made aware of this by asking "who or what do I need to allow this strength to grow within me, both now and in the future?" But also the question: "what can you offer?" is essential for this process.

In this way, the teachers and the children try to review/predict what could happen with individual potential from the point that you decide to seize it, stimulate it and let it grow.

To make the above questions more concrete, the content from the morning's project is related to Cradle to Cradle ideas. A link is established between nature and humankind by looking at growing plants/trees. Together, they look at how nature manages these processes, from planting a seed to a plant growing. What ensures that

a seed reaches its full potential? What does a seed need? Consider, for example, environmental factors, food (what's good for one plant, may not be good for another), plants that grow on their own, plants that grow together. But also back to the human perception: 'what actually makes a plant beautiful?' During this project morning, 'the seed' becomes the symbol for the children's 'human potential'; the potential that must not be lost.

Below are the step-by-step stages the children went through to look at the seeds, with which they want to do something to let them grow.

1. Introduction

Film fragment: <http://www.youtube.com/watch?v=8jP8CC2rKj4>

'The Secret' Your place in the world!

Talking about Cradle to Cradle.

Using PowerPoint presentation/film images to illustrate the relationship between human potential and nature. C2C in relation to products and in relation to humankind.

2. Brainstorm: what are my seeds?

Brief instruction; the relationship between seeds in nature and your own seeds.

Each child gets a little sign on their back on which the other children write down what seeds they think the child with the sign has. This is done per table first and then with the whole class.

The child can then look at the sign themselves, but the question is whether they share their classmates' opinion. The child then adds to the sign by asking what other seeds they know.

All the seeds are then collected in the 'thought bubble'.

3. Choosing a seed

The following step is choosing a seed that you'd want to let grow.

Place this seed in a word cluster, for example 'helpfulness', and think hard about why you'd want to let this seed grow.

What could this seed mean/contribute to you, others, the environment/world, both now and in the future? Or in other words, what could you or would you want to do with it?

4. The behavioural pattern diagram: how do you want to let it grow?

Film fragment: Niger: what do seeds need to grow?

http://www.schooltv.nl/beeldbank/clip/20051031_niger01

What does your seed need to grow?

Brief instruction and example for the behavioural pattern diagram (BOTG).

After that, the children use the diagram to show how they want to let their seed grow. They also indicate who and what they need for that and where they want this to happen.

5. Sharing with each other

The children are set the task of talking about their diagram and listening to the stories of the other children in the group.

They share their diagram with a boy and a girl from another group.

The question in this case could be: "could I also mean something to the growth of someone else's seed?", or in other words "what can I offer?"

Brief feedback; what did you hear from the others that you found special?

6. Feedback, evaluating

Brief question to the teachers: what did you think of the lesson?

The children put together a BOTG about their experience and also get the opportunity to share some tips and compliments.

7. Wrapping up

The children are all allowed to take a few seeds home to plant. They are invited to share this at school and keep us updated on the growth

of their own seed as well as the real seed planted in the ground. The plant that will grow will hopefully remind them of the project morning and the positive plans to help develop their own seed.

Dot. With a relieved smile the economy student sits back and looks at the last words of his thesis. 'The End'. Then, he looks again. And rapidly deletes the last words. It doesn't feel right to end a thesis on the values of raw materials and how to keep them in cycles with 'the end'. He replaces his words by 'to be continued'.

4.2 Senior secondary vocational education (MBO)

Rob de Vrind, Koning Willem I College, Den Bosch

C2C in construction, energy and climate

As a UNESCO school, the Koning Willem I Regional Training Centre does a lot in the field of sustainability and globalisation. All the students are affected by it. Cradle to Cradle initiatives fit well in the school's policy and strike a chord with students and tutors alike. One of these projects is part of the training programmes on construction, energy and climate. It aims to get students acquainted with C2C and teach them to think innovatively and creatively.

First and foremost, it is explained that companies are currently also involved in looking at the long term where we're going to be living in a world of 9 billion people. All these people are getting older and increasingly want a more comfortable life, job and home, which will result in a scarcity of raw materials and energy. Students should therefore find a point on the horizon; something to work towards in the long term. Forecasting in order to be able to back cast, with students capable of using a plan to determine what steps have to be taken to finally get to that point on the horizon.

What is the ultimate goal in construction? Building without using (fossil) fuels, without using (non-renewable) materials, without using land, without using water and changing air quality. So, zero energy, zero materials, zero land, zero water and zero air. At least this is the conventional sustainability approach.

In Cradle to Cradle terms the approach is different from 'zero'. For example;

- 1 Products are made from defined post-consumer material.
- 2 Biological and technological cycles are separated. Waste = food (and therefore are not contaminated) and the remains are reused in the technological cycle.

- 3 Use renewable energy.
- 4 Less bad isn't good. Always leave a positive footprint behind. For example, waste water is cleaner than the water it is being discharged into.
- 5 It adds value (build houses like trees and cities like forests).

That's not possible???? Yes it is.

The assignment is to design a house based on these principles in groups of four students. Students can take 20 minutes to do so. They then give a presentation to each other on what they came up with, followed by a discussion.

This inevitably leads to a list of C2C principles.

The design is free of offenders such as hazardous substances (see also the editor's note on page 34). That means that the students will draw up a list of all the elements that will be used in a design, which have to be non-toxic and recyclable. Products should also be easy to collect, easy to up cycle and easy to reintroduce into the cycle. An outright ban on hazardous substances and completing cycles will require a great deal of patience. To get there, you have to re-think,

re-organise, re-plan and re-schedule. A first step in this direction is for students to already consider these positive concepts as part of their educational program.

The principle here is that students take small steps because no one ever succeeds in being perfect from the very beginning. Make a start and improve at every turn. Act now and you don't have to be perfect.

If the above is a success, you won't have to cut down as things will get better and become more fun.

And finally, students are shown examples. How does DESSO currently manufacture its carpets? And how did higher and senior secondary vocational education [MBO] students in the Heerlen district of tomorrow set to work?

Editor's note

There is an important distinction between C2C terms and terms such as 'less waste', 'less pollution' and 'the concept of zero'. Those are not C2C terms. While the programs described here have many important C2C elements, it is important for educators to see the differences in these terminologies.

For example, C2C focuses on healthy abundance, not zero. Under zero, the greenest building is one that does not exist!

With regards to the use of hazardous substances, this is possible under certain conditions using C2C. Hazardous substances can be used in technical cycles according to their defined use. It is not recommended assigning students to design free of hazardous substances because right now this is an unrealistic approach.

Building after building is appearing there and people are trying to make improvements and get closer to that point on the horizon at every turn.

C2C is all about thinking creatively and innovatively. Students participating in this project are incredibly enthusiastic and are keen to follow it up in their educational programme. A first taste that promises more.

4.3 Higher professional education (HBO)

4.3.1 Zuyd University, Heerlen

Ludo Kockelkorn MSc

The District of Tomorrow and C2C

(The bottom-up approach for sustainable built environment in the Meuse-Rhine Euregion)

Everything we produce, again and again, is one of the basic principles of Cradle to Cradle (C2C). Whether it's carpets, chairs or buildings, it doesn't matter; at the end of the C2C product's life cycle it will be part of the production process again. Companies apply the concept. The previous Dutch cabinet, the province of Limburg and Zuyd University embrace C2C because it fuels environmental policy and new business and stimulates education. C2C founders Michael Braungart and William McDonough provide concrete and practical pointers for the concept in practice.

The District of Tomorrow (TDoT) programme serves as a research and demonstration platform for new energy and sustainability at the European Business and Science Park Avantis Heerlen/Aachen. The

programme involves a sum of €5 million and 48 partners. This paper will deal with the following important research questions: 1) is TDoT a good tool for mobilising and involving the market?, and 2) is this programme replicable? The keywords are: education, innovation, transition of the Meuse-Rhine Euregion, and tools for cities. You can read more on our website www.thedistrictoftomorrow.org.



The District of Tomorrow

The District of Tomorrow is a good tool for involving the market in C2C

Over the last 5 years, teams of students from several universities of applied sciences and professionals from small- and medium-sized enterprises and cities built training houses in Limburg. All of last year's students from Zuyd University's Faculty of Built Environment designed

'0-impact' or C2C houses. A jury of international experts chose a design that will be built over the next few years with approximately 60 business partners. TDoT is a project lead by Zuyd's RiBuiT; the Research institute Built environment of Tomorrow, and its four buildings and terrain¹¹ are new concepts:

- 2009-2011 passive house => 0-energy
- 2010-2012 exhibitions and demonstration => concept based on 0 (energy, water, air, land, material)
- 2011-2013 energy house => 0-energy or energy-plus
- 2012-2014 recycle house => 0-material
- the terrain will be used for electrical mobility, 0-use of water, air and land.



Building 1 Passive House



Building 2 Exhibitions and Demonstration

C2C congress gave a boost to sustainable built environment

On 1 and 2 November 2007, the first Cradle to Cradle congress 'Let's Cradle!' was organised in Maastricht by the Planet Prosperity Foundation (PPF). The congress intended to bring C2C, an ecological design concept, a step closer to economic development. Over 650 participants from business, government, knowledge institutes, public services, education and other sectors came together in an unexpectedly positive mood. Unexpectedly positive because almost everyone only talked about solutions and there was hardly any discussion of doom, gloom and obstacles. Dutch minister Cramer opened the conference with the mission statement of 'Netherlands C2C frontrunner'. C2C was embraced as a motivating concept for other initiatives such as supply chain management. One of the Cradle to Cradle founders, Michael Braungart, spoke to the public. He emphasised that, if we want this concept to succeed, everyone's expertise and commitment is required, and therefore platforms such as the congress are vital. Just do it and do not be afraid to make mistakes. The C2C congress gave an enormous boost to 'The District of Tomorrow' project by revitalising the higher education and applied science of Zuyd University and its partners.

Editor's note

C2C and sustainability are often mixed up or used as being identical terms. That's not true, there is a significant difference between C2C and sustainability which can best be illustrated by an example:

'It is not useful to develop and produce a TV with a life cycle of 50 years if most people prefer to replace their TV within 3 or 4 years. The TV should be produced in such a way that it can be disassembled after 3 to 4 years and that the used materials and components can and will be reused in other products' according to Braungart. This example illustrates the difference between sustainability (producing a TV with a life cycle of 50 years) and C2C.

TDoT has three pillars: educational innovation, applied research and innovation in the market for sustainable and energy-efficient buildings and technology. These three pillars lead to the three different programmes outlined below. Each programme will focus on developments in buildings and urban regions that are the forefront of the industry. The programmes should provide the partners with the latest examples of good practices and support research into this unavoidable future of sustainable built environments. C2C and the

concept of 0 (energy, water, air, land, material) will be the foundation for our projects. One of the challenges was to increase the number of students and companies who could participate in the programme. In October 2010, approximately 250 Bachelor's students passed the new type of exams.

The District of Tomorrow is a replicable programme

TDoT can be considered a replicable programme and this can be demonstrated by several programmes. The educational transition started in 2005 with three training houses in Horst and Weert in the northern part of Limburg. An upgrade was carried out at Avantis and in cities in the region, starting with a project in Kerkrade West. Participants were challenged to copy best practices. In February 2010, students from Heerlen, Aachen, Liège and Nizhniy Novgorod started an international design programme. Three other programmes worth mentioning are described below. TDoT was also a starting point for the international sustainable building conference, SB10 Western Europe. SB10 was held between 11-13 October 2010 in Maastricht, Hasselt (Heusden-Zolder), Liège and Aachen, which are capitals of the provinces in the Meuse-Rhine Euregion, whose 4 million inhabitants speak three different languages and live in five provinces, each with different regulations on (sustainable) building.



The Meuse-Rhine Euregion

The relationship with similar experiences in the world (EU and BRIC countries) will be a new challenge. The programmes described below consist of three pillars: a) educational innovation, b) applied research in cooperation with public authorities, and c) innovation in the market for sustainable technology and energy-efficient buildings. What can be learned is important. The District of Tomorrow acts as a catalyst for a sustainable built environment.

Programme: Future-proof Technology Education in Parkstad

The involvement of so many parties in Limburg in the training projects in Horst and Weert was quite unique. Unfortunately, a written or transferable way of working wasn't available, due to a lack of time and money. Relevant guidelines were lacking during TDoT's start-up.

Started in September 2010, Future-proof Technology Education in Parkstad is the name of the programme financed by Het Platform Beroeps Onderwijs (HPBO). Parkstad is a collaboration between 7 cities in the south-eastern part of Limburg, the Netherlands, close to the border with Germany and Belgium. The programme aims to develop a transferable method or way of working for TDoT and other universities, vocational schools and the business community. The main goal is to set up pilot projects that should lead to better vocational education by way of flexible study programmes, new training packages and new support structures. The motto is: together we will create our own future. The educational interventions show what has to be done in and outside schools. The practical learning community for a building, project or real-life problem is the way in which this can be done.

Programme: Cradle to Cradle and the province of Limburg

The District of Tomorrow acts as a catalyst for a sustainable built environment. TDoT is one of the main examples of sustainability that the province of Limburg will showcase to other EU regions. The province is the programme leader for the Interreg IV-C Cradle to Cradle programme.

The Cradle to Cradle (C2C) approach on waste provides a breakthrough in waste prevention and production in closed cycles. The C2C concept

envisages a challenging future, where the emphasis is on creating eco-effective solutions. The power of C2C lies in its ability to mobilise and inspire. The Cradle to Cradle Network (C2CN) in Limburg is a capitalisation network that aims to reduce the use of raw materials and generate less waste and less environmental pollution while enhancing innovation and economic development¹². In addition, C2CN encourages more recycling in society. Zuyd University is a C2CN member. The C2C approach is in line with Zuyd University's '0 concept'. Zuyd University will become the sparring partner for networks in other EU regions.

Programme: IDES EDU

The overall objective of IDES-EDU is to create education and training courses for students and post graduates in the field of Integral Design for Energy and Sustainability (IDES) in the built environment. The aim is to implement multidisciplinary EPBD (=Energy Performance Building Directive) teams and meet the targets set by the EU. The courses will be developed within national consortia in which the educational institutions will collaborate with relevant key players and stakeholders, such as representatives and organisations in the building sector like constructors, real estate developers, architects, research institutes, users, suppliers and consultants. For TDoT, this is a third pillar to innovate the market for sustainable and energy-efficient buildings and technology.

In order to achieve this, IDES-EDU will develop postgraduate and Master's courses and training packages at 15 European educational institutions. These will be based on horizontal themes (EU-wide issues based on EU perspectives, visions and policies) and based on vertical themes (specific needs from stakeholders, especially in the building sector). The courses will be developed and implemented by the participating educational institutions. This will be done with end-terms, accreditation and a framework for common certificates in 15 countries. The programme aims to involve: 600 students, 150 architects, 300 engineers and 150 miscellaneous professionals. However, the overall targets on energy consumption, CO₂ reduction, percentage of renewable materials and base components are considered a horizontal theme activity for The District of Tomorrow.

Conclusions

TDoT is a useful tool for involving students and businesses in the C2C process. An upgrade will be carried out in the region and participants are challenged to copy the best practices. The results are replicable in the region and far beyond. The transition to a sustainable built environment starts with a) formulating the target (=what) for the Euregion in 2030, and b) implementing practical learning communities (=how) for buildings, projects or real-life problems. Educational intervention is necessary to achieve these goals. Together we will create our own C2C future.

4.3.2 The Zeeland University of Applied Sciences, Vlissingen

Brigit Pommee MSc

The Zeeland University of Applied Sciences' Sustainability and Water lectorate has been actively working with the Cradle to Cradle concept since 2007. Initially, an investigation into the business community's interest in Cradle to Cradle was launched on behalf of the province of Zeeland. It soon became apparent that there were five enthusiastic companies that wanted to set to work with this concept. Within funding from a RAAK Light subsidy, a process was started with the central question being "how do you make products and processes Cradle to Cradle?".

Zeeland University of Applied Sciences set to work with these five companies in September 2008. Five working groups, one for each company, were set up with Engineering and Economics students. A company representative, one or more students, and a tutor made up each working group. There were five assignments in total: to design a machine for separating the PP (polypropylene) thread for a tomato grower (Lans in Rilland Bath); to investigate how a production process could be improved so that PVC is no longer required (Delta Glass in

Tholen); to design a C2C smoke flue for a roof (Ontop Metaloterm in Middelburg); to develop a new product-market combination for a biopolymer (Imperial Ventures in Bergen op Zoom); and the C2C certification of a biodegradable cleaning product (Ecopoint in Halsteren).



Examples of product development by Imperial Ventures

The first four were more technical projects and were very suitable for the Engineering and Industrial Design students; the last one was more of an economic/business management issue. The assignments took the form of an internship/graduation project or introducing a practical exercise into a research course. A group of students from Delft University of Technology set to work on the assignment for the product-market combination. In that way, practical experience could also be gained from collaborating with a university of technology.

The results of the five projects are documented in a brochure (Cradle to Cradle in Zeeland, 2009) published by the province of Zeeland. The companies are enthusiastic about Cradle to Cradle and the role that both the University for Applied Sciences and the province played. The major advantages for the companies was the intensive coaching by and the commitment of the University of Applied Sciences. The owners of the small- and medium-sized businesses themselves could not spare the time to take on something as new as Cradle to Cradle, and also appreciated the role of sounding board that the school played, as well as the assistance to expand their network and the knowledge and skills of the University of Applied Sciences' network. For the students, they proved fascinating practical case studies, two cases of which resulted in a patent application and a C2C certificate. It was a way for the University of Applied Sciences to gain Cradle to Cradle experience and a way for the province to encourage sustainability in practice.

Collaboration between the University of Applied Sciences and the province has resulted in a number of follow-up projects. Recent ones have focussed on Cradle to Cradle and construction/area development. Students from Delft University of Technology are involved in the Interreg Cradle to Cradle Islands project to design a floating marina office, while a Zeeland University of Applied Sciences' Aquatic Ecotechnology student is researching how the biodiversity in lake Grevelingen can be further

increased using floating objects. In this case, the province's spearheads and the research topics within the University of Applied Sciences are mutually reinforcing.

A recent assignment for the province of Zeeland was to develop a power-generating sports appliance. Four teams of fourth-year students of the minor in Consumer Products for Engineering took on this assignment. The four groups all designed their own specific appliance. Given the complexity of the assignment, the focus was on generating power and the fun element, with less attention being paid to the material aspect. This could be addressed in a follow-up project. On 31 January 2011, the Zeeland University of Applied Sciences' students presented their prototypes at the Groene Sportschool ('The Green Gym') symposium in Vlissingen.



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4.3.3 The Amsterdam Fashion Institute (AMFI)

Jan B.M. Piscaer, Linnemore D. Nefdt

(interviewed by Pieterneel Boer)

Digesting fashion

In the 1990s, AMFI started to teach the effects that working conditions legislation had on the apparel industry, which raised student awareness of workers in the fashion supply chain. In the industry, Modint (The Trade Association for Fashion, Interior Design, Carpets and Textiles, and AMFI Advisory Board member) paid attention to quality management, with environmental management and corporate social responsibility following a little later on. It promoted this with 'a time-saving package' of ISO-9000, ISO-14000 and CSR. AMFI ran with this idea and extended it to include raising awareness of sustainability. At the turn of the century, AMFI still had a black and white approach, but it gradually opened up to more individual interpretations of sustainability. The annual Beyond Green event is evidence of this as it is open to all Bachelor's fashion students in the Netherlands. Nowadays, every self-respecting fashion brand and/or retailer has sustainable styles in the shops. Claims of sustainability in fashion collections are made when there is some proof of fair trade, organic or climate-neutral

manufacturing. Others, meanwhile, can show you that every step in the process is taken according to verifiable sustainability standards like bluesign® or the Fair Wear Code of Labour Practices. This variety in sustainable apparel may score points with consumers and students, but it creates a blurred picture of sustainable fashion. Clarity is essential for future fashion engineers, who are responsible for contributing to a liveable world and for ensuring their work will be beneficial.

The sustainability approach of decreasing the amount of carbon emissions, waste, and non-renewable sources to produce apparel seems effective. However, it only *appears* to be efficient because fashion will continue to pollute and deplete the planet. Imagine the future with a bikini instead of a fur coat: you still need polyamide, elastane, logistics, etc. to get a bikini in your clothes drawer. Increased fashion awareness results in consumers' closets becoming crammed with clothes. Add to that the growth of the world population over the next few decades and you get an idea of the growing challenges that the fashion industry is facing to produce beneficial products with a reduced impact on the planet. It should be clear that waste production is at the core of the fashion industry, in both the pre- and post-consumer phases, and especially with the unstoppable desire for fast fashion. Despite all the efforts to reduce, reuse, recycle for the benefit of sustainability, we are fighting a losing battle. This downward spiral that

could ultimately lead to the demise of the industry has to be dealt with. With C2C we can have our cake and eat it too. Its acceptance of our inherent wanting and needful nature and its systematic approach to dealing with the core problems of energy and waste seems so logical and pragmatic. Cradle to Cradle provides a fertile ground to design fashion products that continue to nourish the next lifecycle of the product and remain beneficial for the planet, so consumers, the fashion industry and students can celebrate fashion abundantly, instead of disturbing the planet by leaving damaging footprints. AMFI, however, will not abandon its programmes on fashion and sustainability, because the achievements from the people-planet-profit approach have so far proven a perfect basis for gradually shifting towards Cradle to Cradle.



PEPERJEANS: inspired by forms of nature. Washable laminated paper + coating; cellulose pulp after life. Wooden buttons, recycled PET zip, charcoal dip-dye T-shirts & printed with used newspaper headlines. (Jasmine Tjon Sie Fat, Kin-Mei Wong, Britt Glas, Eva Steinkühler. ©2010 AMFI – pictures of C2C concepts by 2nd year students)

In January and February, 2010, three AMFI staff members attended the Cradle to Cradle in Higher Education masterclass at Erasmus University because they had become slightly suspicious about sustainable fashion expressions like 'climate-neutral suits' (a poor score for planting trees to neutralise apparel) and '100% organic cotton' (as everybody knows that cotton is not such an environmentally friendly material). We longed for a positive approach that created the opportunity to bring fashion to a beneficial level. In addition to a very inspiring and convincing master class crew, Michael Braungart would give feedback on our work: the best opportunity to learn from the source. After the masterclass, we decided to try out C2C in a mid-term pilot and apply C2C to the second-year 2010/2011 curriculum.

Inspired by the masterclass and with the aim of launching C2C in fashion, a roadmap for sustainable fashion was drawn up. This was communicated at the 2010 IFFTI conference to fashion institutes world and included the following: in 2018 all products are beneficial; in 2015 all products score at least 50% on *our* sustainability scale; in 2011 all products have well-founded sustainability aspects, and in 2010 AMFI's knowledge to implement sustainability is open source shareware.

The pilot was carried out over three months with 10 third-year students also doing their regular semester course in developing a sustainable protective wear collection for off-shore plumbers & welders to be sold

in the business-to-business sector. The assignment was to make one item for that collection according to Cradle to Cradle methodology. The imagineer (imagine & engineer) phase encouraged the students to make the garments more protective by thinking of such things as colour-changing fabric in case of danger, auto-healing fabric, and an RFID-chip to locate the worker and count washings. During the next phase, students succeeded in sourcing the right suppliers to develop C2C materials and changed to a zero-waste way of manufacturing by choosing fully-fashioned pattern parts. The only thing left for disassembly was the RFID chip to be used again and again on other products. The garments could start their next life either as compost, or as up-cycled new fabric/garments. The C2C approach took creativity beyond the boundaries of design.

The protective wear company praised the students' work for its design, manufacture and calculations, but it was critical about the retail, care and recollection part, which needed more work. Nonetheless, the company was inspired and enthusiastic about the possibilities of C2C products and will continue to explore C2C for the future.

In September 2010, C2C was introduced as a major subject in the Basic Blue (Jeans) semester for 76 second-year students in 15 groups. The semester modules consisted of C2C concepts, market research,

jeans collections, retail environments and business plans.

The concepts (see illustrations) were presented at an inspiring runway event where not only the C2C prototypes were shown, but also the origins and post-user destinations of the garments. The students succeeded in convincing the audience to support their ideas on the road towards commercial translation. The collections added a broader and more digestible interpretation of the concepts, while the retail environments were set up to communicate the concepts to the consumers.

The business plans, however, mostly followed the well-worn path of convincing banks with financial figures, as C2C business opportunities were hard to find. Only a few C2C components were mentioned, such as deposits, cooperation with the textile industry and reverse logistic specialists, or the long-term effects on people and the planet of beneficial products and derivatives such as changes in buying and consuming behaviour.

The semester taught us that more time should be set aside for discussions during the process to let students (as well as staff!) fully consider the possible implications of Cradle to Cradle as a convincing and competitive business opportunity. In addition to extra time for discussions, AMFI will have to invest in databases and facilities for

chemical testing to be able to categorise clothing components as acceptable or unacceptable for C2C products.

AMFI continues to teach C2C where it can, because we feel that Cradle to Cradle is just the starter that will allow future fashion engineers to elegantly enjoy their fashion career dish.



RE.AD: Rethinking Adventure → Re – ad(d) → Re.ad.
Kids' wear made from worn trousers; left overs and waste is transformed into tree hut furniture
(Maxime Bos - Leonore van der Kolk - Lisa de Rooij - Charlotte Verkeyn - Juanita van Zanten.
Models: Hendrik & Dennis. ©2010 AMFI – pictures of C2C concepts by 2nd year students)

4.4 Foreign cases

4.4.1 Germany: REAP (Resource Efficiency in Architecture and Planning)

Prof. Dr. Wolfgang Dickhaut, Dean of REAP Master & Jenny Pfau, lecturer & scientist EPEA, Hafen University, Hamburg

October 2009 marks the start of a new Master's degree programme at Hamburg's HafenCity University called REAP (Resource Efficiency in Architecture and Planning). This is an opportunity for those wanting to increase their knowledge and understanding of innovative technologies that can contribute to a more sustainable urban built environment.

The main emphasis of the programme is on technology that provides urban and building services, but it also investigates the socio-economic context in which these services are provided and managed.

The programme:

- provides an overview of the complex relationships between building and urban services technology (i.e. building construction and renovation, energy and water supply, waste and wastewater management) and the environment (i.e. resources and space consumption, impact on environmental media and ecosystems);

- offers insight into patterns of user demand and behaviour and how they affect the interaction between technology and the environment;
- provides information on resource-efficient technologies, e.g. energy generation from renewable sources, as well as underlying principles, such as source separation and closing material cycles, demand-side management, decentralised, modularised service provision, etc.;
- reviews experiences with and conveys ideas for different forms of legal and economic organisation for planning, construction and urban services provision;
- teaches study and research methods and techniques for planning and decision support.



This HCU programme is for people from all over the world with a wide range of academic backgrounds and work experience who share an interest in technology and society and a concern for urban life. The Master's is taught in English and does not require an expertise in architecture or engineering. It does not award a professional degree in architecture, urban planning or civil engineering.

The Master's programme consists of 18 study modules taught over 2 academic years. They have been put together to benefit from the faculty members' expertise and the interdisciplinary synergies between the various topics.

Areas covered include:

- Sustainability
- Energy in the city
- Solar architecture
- Energy technologies
- Water in the city (urban hydrology)
- Water and wastewater technologies
- Material cycle and material flow analysis
- Urban noise
- Urban climate and microclimate
- The economics and administration of building and urban services

- Legal and policy instruments
- Research methods, planning and decision-support techniques
- Geographical and cultural context

The challenge of sustainable development in the building sector offers great possibilities for social, technical, and creative renewal in a sector of the economy that has long since ceased to be regarded as particularly innovative. It also offers fresh export opportunities and enables construction to once again act as a catalyst for long-term social trends. Thinking from house to city, via the district: if you turn attention from the individual object to the district and the city as a system of networks, it is possible to see how the demands on individual buildings could be combined with a focus on the whole picture. Instead of every single building standing alone, it is connected to the environment, district or city. Living in a society is connected to energy and mobility and especially material flows and material demands.

Building in times of change means engaging in a more intense, design-related debate. Buildings should be seen less as a bulwark against nature and should instead be envisaged, conceived and built in harmony with nature. What is at stake is no less than a revolutionary reorientation of the way we deal with raw materials, energy and lifestyles – comparable only to the huge technological upheaval of the first Industrial Revolution.

By introducing and addressing different concepts of 'material flows' and focusing on this relationship as well as on the Cradle to Cradle concept, the students learn to think in a more holistic way to try to get a deeper understanding. It is an interactive class as well and students will be given theoretical background and guidance, but work on real cases too.



What is possible? What are the options if we imagine 'houses like trees, cities like forests'? And what are the bottlenecks and questions that need addressing? It is not nature striking back, but an interactive dialogue between buildings, architecture and the environment. This course wants to go beyond looking at architectural designs and materials from another perspective; it wants to expand horizons and open

students' minds. It will focus on materials and ask questions about how to choose the right material, for what purpose, how to consider material flows, where would a flow start and where would it end, how to deal with material pooling ideas, etc. The programme will also raise questions about imaginary and real projects in the architectural field (single buildings as well districts), looking at them as a 'design capsule' or as an 'island' disconnected from the 'mainland', but also connected. It will also address how we can look at materials from a Cradle to Cradle perspective, and look at the criteria behind selecting materials as well as how the concept of biological & technological cycles can influence the choice of materials. Other areas will address how to consider the materials themselves as nutrients and how to keep them in a cycle. What is the right material? Does 'the' right material even exist? Or do we have to ask additional questions? How can you identify beneficial materials for people and the environment that are not damaging? Which labels or certificates can help decision-making? What criteria should be considered? How can 'material flow analysis' or 'life cycle analysis' help guide the process? What is meant by 'lifetime of a product'? What kind of architecture should be addressed – new buildings or re-designing and re-developing already existing buildings and districts? A building of today could serve a different purpose in 50 years, so how should this be considered when it comes to materials? How should modular building

be included? What would the role of an architect as a designer be in this context? What role can they play in this interactive field? Material can be chosen based on performance, function and haptic aspects, but other issues need to be considered that reflect cultural or regional differences, technological diversity, and, of course, economic aspects.

In summary:

This REAP module 'Material Flow Analysis and Life Cycle Assessment: Material Management and Cradle to Cradle Design' focuses on 'From Sustainability To Cradle to Cradle', starting with the conventional sustainability concept and vision (standard qualitative and quantitative aspects) and then looking beyond this towards the Cradle to Cradle concept. The module will challenge students to rethink current practices and develop an understanding that is beneficial for the environment, lucrative for the economy and good for society. Cradle to Cradle is a design philosophy that empowers society to model its production processes on the principles of nature, where quality and effectiveness of material and energy flows are central features. It focuses on innovation to enhance the quality of products and processes and is an entrepreneurial concept that starts by determining the intended benefits instead of just focusing on environmental impact.

4.4.2 Denmark: Niels Brock Copenhagen Business College

Charlie Mpengula, Learning Facilitator at Niels Brock Denmark and Leicester Business School (UK). He is a certified Cradle to Cradle Educator trained at the Erasmus Academy Master class in Rotterdam.

Niels Brock Copenhagen Business College is Denmark's largest business college. It has four faculties covering all core business education areas and it provides students with the business administrative competencies to progress within or apply to business or further research fields. Niels Brock's position in the Danish business community is one of the most significant in the country, as every year 15% of all Danish graduates in vocational educational business training come from this college. It also trains 20,000 people every year in adult and corporate education, and teaches 35% of all higher education business graduates in the greater Copenhagen area. Furthermore, 21% of the student population pursuing higher commercial courses in Copenhagen trains at Niels Brock.

Implementing worthwhile change can take time

Niels Brock's prominent position in the Danish business education sector is also a result of its commensurate challenges to integrate

Cradle to Cradle principles into the educational programmes at the business school. Launched in 2010, the integration plan is a new and ongoing one that is slowly but surely seeping into various courses. Since 2010, there have been three major advances in integrating Cradle to Cradle education at Niels Brock: the competence development of Niels Brock faculties to introduce them to the foundation of greening business and Cradle to Cradle philosophy, training entrepreneurs in the business incubator, and introducing Cradle to Cradle issues into some of the curricula and international educational partnership programmes.



Competence development for staff

To embed Cradle to Cradle education in the various faculty programmes at Niels Brock, it is vital that teaching staff receive competence development training. A pilot project designed by the business school's Centre for Innovation, Entrepreneurship and Incubation and financed by FUUH Denmark was carried out in 2010. It was attended by ten faculty members representing a broad spectrum of courses. A network of more than 15 companies and organisations participated by presenting their business cases, practices and experiences with Cradle to Cradle and greening business strategies. At the end of the course, the highly energised participating faculty members produced hands-on projects with recommendations on how to integrate Cradle to Cradle education and greening business into their respective courses. Within a month of finishing the competence development course, some of the project recommendations were already underway in the various faculties. These are summarised below

Cradle to Cradle education in course modules

Cradle to Cradle issues are being introduced into the various courses as a result of the competence development course. For instance, undergraduate marketing management students in the Professional Bachelor's programme will have to work on a Cradle to Cradle

case and analyse it from different perspectives, including logistics, organisational, financial, economic, marketing and sales, and legal. A Cradle to Cradle course elective is also offered in the sixth semester of the undergraduate programme.

The Academy Profession degree (associate degree) in Marketing Management has added real case studies that incorporate Cradle to Cradle and greening business principles. Students are required to write a marketing project on a problem based on the real case studies. In the entrepreneurship elective, Cradle to Cradle principles have been introduced into the curriculum, and students' business ideas are challenged using a triple top line approach to encourage students to rethink their design at the conception stage.

Niels Brock is home to a business incubator called INK, a successful project to integrate a practical dimension of business life in Denmark that supports young entrepreneurs with starting their own businesses as they study or work within the greater Copenhagen area.

Entrepreneurs in the incubator participated in Cradle to Cradle training workshops designed by INK. This inspired some of the start-ups to base their businesses on Cradle to Cradle principles, while others were deeply challenged and started to consider how they could redesign

their project start-ups. In April 2010, a Cradle to Cradle conference focusing on intrapreneurship and entrepreneurship was held where a number of companies in the industry made presentations culminating in panel discussion. These companies included IKEA Goes Renewable, Better Place, COWI Consultants, Vugge til Vugge Denmark (Cradle to Cradle DK), Amagerforbrænding (Amager's incineration and waste plant, Copenhagen), the Danish Confederation of Industry (DI), and Fornlysesfonden (the Business Innovation Fund).

The Retailing programme in the Faculty of Vocational Educational Training is planning a green retail course incorporating focal points such as Cradle to Cradle issues, fair trade and waste management. The Faculty of Adult and Corporate Education is planning a corporate course that includes Cradle to Cradle principles with prospects for the Danish and Chinese markets, while the Higher Commercial Course Faculty is planning a course catalogue offering innovation courses that involve Cradle to Cradle design principles and other green themes.

Introducing Cradle to Cradle into international partnership activities

Niels Brock's International Office has made a significant impact on green business education among international partner universities. As a result of Niels Brock's influence, an enviropreneurship course (ecopreneurship) has been adopted by 12 universities and institutions

of higher learning in Northern and Eastern Europe under the Ekotek Nord programme. This course, which includes an introduction to Cradle to Cradle, has proved popular and is being continued between 2010 and 2012. Niels Brock has been involved in designing and teaching this course.

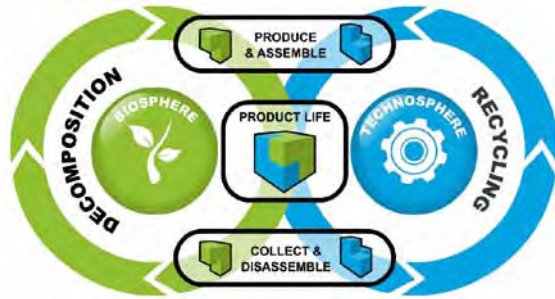
“When a small step is actually a giant leap, be sure to tell the world!”

Below are the small steps taken to create mainstream Cradle to Cradle education at Niels Brock. Implementation will call for more time, shared vision, motivation and financial resources for the integration plan. Some insights the author gained about establishing Cradle to Cradle education are summed up below.

- 1 Ensure leadership and employee engagement and support at the earliest possible stage. Without advance leadership support, nothing can be done.
- 2 Do not start big, but establish a pilot project instead and gradually build on this.
- 3 Use your contact network, open it up and share it with others. This is a useful practice that will earn positive acknowledgement and free support and assistance from your network. No man is an island.
- 4 Cradle to Cradle education tends to win the hearts of students.

- A highly practical approach to this issue guarantees student enthusiasm for assimilating the challenges of the programme. Students often remember what is dear to their hearts and this is a sure way of building responsible future leaders from the very beginning.
- 5 All business courses can incorporate a Cradle to Cradle dimension. In the pilot project conducted, we were able to find the ‘green thread’ in the various courses and programmes involved. Courses were not hand-picked in advance to be represented in the project. The results and stories from the recommendation stage were self-evident. All the courses combined told a common story.
 - 6 The Danish government would benefit from working faster on integrating green business educational curricula into core business educational programmes. This calls for introducing Cradle to Cradle and greening business training into higher vocational business training and other non-vocational professional postgraduate business courses across Denmark. In the long term, this will save budgetary demands in state-owned business schools that replicate competence development courses on their own that could otherwise be taught by future faculties during professional training.
 - 7 By educating future and current business executives and administrators in Cradle to Cradle and greening business principles, Niels Brock and other business schools will significantly

contribute to the progress of responsible management education in Denmark and hence accelerate Denmark's positive environmental footprint on the world. This development would in turn fulfil the United Nations Global Compact for the satisfactory delivery of responsible management education.



4.4.3 Denmark: C2C in teaching at technical colleges in Denmark

Søren Lundsgaard, Teacher at Denmark Technical College, Lyngby

The development part of the project, which was completed with support from the Danish Ministry of Education, was instigated to spread the knowledge of 'Cradle to Cradle' thinking (C2C) throughout the HTX system (technical high school) and inspire teachers to

incorporate C2C into teaching technology, social science and chemistry. It has been standard practice in technology courses in particular to address environmental issues, often using the concept of 'life cycle analysis' (LCA).

In the project's development component, which was undertaken by Lyngby technical high school (a high school under TEC) and Odense technical high school, the teachers demonstrate how this way of thinking can be implemented as part of specific teaching practices and serve as inspiration to others.

According to the teachers who worked with C2C this meant that students were not only working on resolving problems, but they were also able to assign creative, innovative and entrepreneurial aspects to the work. There has been a considerable focus on reflection, interdisciplinary teaching and innovation. It is clear that by bringing C2C into HTX teaching, life cycle analysis becomes far more relevant and motivating for students. Furthermore, the C2C paradigm points to new ways out of our environmental problems.

The philosophy of C2C is that instead of producing waste that pollutes/fills our landfills, we should design our lifestyles and modern consumer goods in such a way that the waste will become a 'nutrient' for subsequent generations of products, raw materials, etc..

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C2C is a quest to design with the 'whole life cycle' in mind. Instead of producing products that do less damage or choosing a lifestyle where we consume less, it's about creating products, houses, whole cities, cars, etc., that actively contribute to the life cycle and provide future generations with a production base that can form the basis for healthy living systems. The principles of C2C are ideally about an industrial revolution, where the economy and the environment form a higher unity. In this project, working with the new manufacturing paradigm has led to a fusion of LCA and C2C, where the C2C perspective 'builds on LCA'. The next natural step, therefore, should be changing the question of 'how to get rid of the waste and recycle it' into 'how do we turn waste into a nutrient for subsequent production cycles'.

The actual teaching

Initially the students were taught to work with classic life-cycle analysis (LCA). This approach will not be commented in this paper, but when working with C2C first gained momentum students ran into technical issues/problems which caused a certain level of frustration. Other students ran into similar problems. After several crisis meetings reaching the development team decided that the following approach is a fundamental prerequisite to working with C2C in education:

One must be realistic. 'Perfect is the enemy of good' – you are not supposed to stop! The solutions for the problems found may not be optimal, but they can improve the environmental situation. The requirement for an optimal solution would be research at an academic level, for which high-school students do not have the necessary skills.

The following hierarchy with the optimal solution at the top can be established:

- Avoid waste (C2C)
- Recycle waste (e.g. glass-recycling, C2C)
- Recycle (e.g. paper)
- Recover energy (e.g. use paper for fuel)
- Repository

It's quite a breeze. And the team stands at the windmill. The teammembers smile at each other and the teacher looks at their faces: "Ladies and Gentlemen. We did it. We... are generating our own electricity from now on. Who'll make us a cup of tea with our own wind powered water boiler?"

Land filling should be avoided completely and the basic aim is to move as high up the hierarchy as possible.

The following ideas were then tested further:

- Cigarettes with cardboard tubes
- Collection stations for cigarette butts
- Campaigns to stop smoking
- Non-optimal solutions for the problem, but a step in the right direction

The point is that C2C offers students an approach to roads that can be explored so as to completely avoid the environmental problem. This is something they did not get from previous environmental education.

What connection is there between LCA and C2C? How can C2C enrich LCA analysis? The fundamental difference between these two approaches to environmental education is that LCA is a quantitative approach that identifies various environmental impacts and categorises them by numbers. C2C is a qualitative approach that not only takes stock of the environmental sinners, but also identifies paradigmatic solutions, where raw materials circulate and are included in the cycles again.

Nonetheless, the two perspectives are linked in an educational context because environmental impacts can be identified through LCA analysis, and then students can work with creative, innovative and enterprising ways to find solutions, such as the aforementioned hierarchy, which can subsequently contribute to reducing environmental impact. As we have already said, this is not optimal, but at least young minds have been introduced to C2C logic. Furthermore, it has been reported that C2C interests young people to such a degree that they can stay focused on the approach for their three years at high school

Quotes from teachers at a conference on C2C:

“Working with Cradle to Cradle takes time, but it is also an eye-opener and a new and exciting angle. Young people in HTX were really taken with the idea.”

“In the past, environmental education was just something they (the students) had to endure, and they were unmotivated. For me, it (C2C) meant more fun - and likewise for the students. Now they want to do it!”

“I’ve been using Cradle to Cradle as a lever to create energy in the class, which probably wouldn’t have been there otherwise. Students have become far more nuanced and formed, and it has raised the educational level.”

“When I teach the usual environmental education material students are 80% engaged, but when I teach them about C2C they are 200% engaged.”

Two examples of student cases concerning Cradle to Cradle design are presented in the appendices.

4.5 University education

Tanja Scheelhaase PhD, University of Twente

(interviewed by Pietermel Boer)

This C2C Master’s programme is unique and, so Tanja Scheelhaase PhD tells me, it’s actually one of a kind in the world. It’s the first ever C2C learning programme, putting the Netherlands in pole position. The curriculum and teaching methods have to be developed here. At the time I was visiting Twente, during the final presentations of the first semester, a German film crew was making a documentary for a prestigious German television programme. It showed the international interest in C2C. It was Michael Braungart though who provided the opportunity to also film the students at work. *“What has been done, is*

history. You are the future", he told the students. Some of them then got the opportunity to present their design to an audience of no less than 7,5 million Germans! A good start to your career as a designer, I'd say...



The C2C Master's offered at the University of Twente is an initiative from the city of Venlo which also sponsors this chair. Venlo..? In Twente?! You may well ask... Well, the municipality sees C2C as the main driver for innovation, product development and sustainable growth over the coming years. Technological innovation is crucial for businesses in the region and knowledge innovation is, therefore, a vital way of achieving this. C2C ExpoLAB is the organisation responsible for fulfilling these ambitions (see also 2.3). This foundation is developing a

C2C knowledge and educational infrastructure in the Venlo area in which the C2C chair of learning at the University of Twente plays a central role. The C2C ExpoLAB links government organisations, knowledge and educational institutes and the business community in order to boost C2C implementation as well as document processes of C2C applications in buildings, regional development and products, and also validate them and open them up to other parties. All together, a very fine example of parties with a visionary perspective working together!

The curriculum for the Master's programme was developed by Prof. Dr. Michael Braungart and Tanja Scheelhaase PhD. I asked Tanja Scheelhaase PhD what the most important thing is when developing a C2C learning programme. First of all, it is very important to make students *think*. Think? Isn't that what students are always supposed to do when they're in class? Yes, but in practice students still often have a rather passive consumerist attitude that is not good for thinking. So, make them think and participate actively. Let them consider the consequences of an idea, instead of the consequences of an 'already-made product'. Think before you do. It's about doing the right thing, instead of doing things right.

Teaching Cradle to Cradle is also about making students feel responsible, e.g. by raising awareness of what elements are in a product, the effects these have on human beings and the environment. In other words, making them aware of the effects of badly designed products. The programme does more than raise awareness though. It focuses on designing new Cradle to Cradle products; products that are good for you and the environment. It's about leaving a beneficial footprint, instead of minimising it. To achieve this, an open, creative and safe atmosphere is essential. Students will then feel invited, participate actively in discussions, raise questions and communicate.

Cradle to Cradle is much more than design. It's a mindset and, in that respect, the language used in your teaching is also important. Cradle to Cradle is a positive approach, so the language should be used in a positive way too. It's about support and about focusing on the positive side. Don't force your students, but encourage them to think independently and allow them to choose their own direction. Cradle to Cradle is to *offer* something.

Tanja Scheelhaase also stresses the importance of 'seeing the greater picture', of looking at the whole cycle, instead of just the one small piece related to your own field of expertise. Describing the interrelations and complex connections is, therefore, very important. Repeat it again

and again as it is forgotten so easily. It's all about quality, which we can reach by stepping back and broadening the horizon. Interdisciplinary education is extremely important to Cradle to Cradle teaching. At this stage, the Master's programme only comprises students from the Industrial Design Engineering B.Sc., but the objective is to involve students from all different Bachelor's programmes.

Tanja Scheelhaase PhD's most positive experience when developing and teaching this Master's programme was communicating with the students and the positive energy generated when thinking and discussing Cradle to Cradle with them.

With a lot of noise and
rumble the toilet flushes.
Kim runs to daddy and sits
on his lap. "Great sound
isn't it dad?" "Great sound
is what my little girl?"
"The sound of nutrients of
course, dad! Miss Stella told
us all about it yesterday."

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4.6 Master class for trainers and teachers at Erasmus Academy

Ljiljana Wiersma-Rodic PhD

(interviewed by Pieterneel Boer)

Students and teaching staff ever more often incorporate Cradle to Cradle in their studies, education and research. The Cradle to Cradle masterclass seeks to guide and support educators in these efforts and is intended for academic staff from universities and hogescholen (Universities of Applied Science) who want to develop Cradle to Cradle courses or get more input for their existing course.

Why was this masterclass developed?

At the Cradle to Cradle Academic Chair we were getting requests and questions from lecturers who either wanted to integrate Cradle to Cradle in their education or had already undertaken first steps in that direction. They had a lot of questions on methodologies to do this, as well as critical questions and remarks about the concept of cradle to cradle. Therefore we decided to develop this masterclass for educators.

Was this masterclass a success?

Yes, it was indeed! There was so much enthusiasm, energy and genuine involvement. The participants were very open, active and critical. I especially enjoyed the lively and constructive discussions, which were prompted by critical questions and remarks. The atmosphere in class was just great. Cradle to Cradle generates a lot of positive energy.

We had both fundamental and practice-oriented discussions. The participants had very different backgrounds and this enriched the discussions. They brought in professional expertise on their field of study, while we from the Academic Chair contributed the Cradle to Cradle perspective. Together we discussed, sought and came up with answers and directions. Everyone benefited from such discussions, regardless of the professional field, because the questions were similar in every domain.

In addition to addressing various concrete issues from participants' teaching practice, the masterclass generated a lot of inspiration and I think that is a very important part. It was also really nice to see the mindset shift taking place among the participants, moving away from prevention and reduction and embracing positively defined intentions, addition of value and quality as guiding principles.

What do you think is important in C2C education?

'Teaching by example' is very important if we really want to create change. If you look at children, they don't learn from what you say, but from what you do. That is a very natural way of learning. By analogy, if we want to teach co-operation and material pooling in C2C networks, then C2C education should feature interdisciplinary co-operation and knowledge pooling through sharing of information. Furthermore, an important lesson is that a thorough introduction into the fundamentals of Cradle to Cradle is necessary. Finally, educators reported problems related to a lack of sufficient publications and teaching materials in various fields. Adequate literature is really needed and it would be very beneficial to develop it.

How do you see Cradle to Cradle in education in five years?

I don't know if in five years the paradigm as such is embraced everywhere, but its positive attitude and basic principles for sure are. Indeed, this is already the case, right now. People get inspired and activated by its inviting and positive prospects. For example, being good instead of being less bad is a message that motivates teachers and students alike.

Sustainability concerns are increasing and Cradle to Cradle offers an elegant and effective approach to address and surpass these concerns. In order to achieve Cradle to Cradle systems, we need both specialists, who solve concrete issues in various fields, and generalists, who connect various fields. The interdisciplinary collaboration at universities may still be difficult but working together is absolutely necessary in order to be able to ask the right questions and seek answers that will be beneficial to the entire system. A narrow perspective is simply outdated.

Creating possibilities to meet each other, exchange ideas and do something outside one's own field of expertise is very important. Trust, sharing, collaboration, that is the essence of both Cradle to Cradle research and education. The discussions and network seminars, made possible by DHO, are very helpful and useful in this respect. And yes, one last thing. Let us not forget the importance of having fun – learning is easiest when you are having fun!

Background Cradle to Cradle masterclass

Since the introduction of the Cradle to Cradle concept in the Netherlands in 2006 there have been many public and business initiatives to develop the concept in practice and to anchor it in the Dutch society. The Masterclass Cradle to Cradle consists of four

intensive days. The first two days consist of interactive presentations over Cradle to Cradle concept as well as the underlying methodology in relation to higher education, with ample opportunities for discussion. Upon return home participants apply the knowledge in their own fields of education. Two weeks later, the course continues with two days of feedback and exchange sessions.

Chris bows down to her shoes. Looks at her shoe soles and rises back up again: 'But Sir, did you just tell that my shoe soles end up in the water when I walk on the streets?' 'Yes, they do, because you rub off parts of it as you walk.' 'Are these shoes fish proof then sir?' 'Hopefully they will be very soon Chris.'

Month 10

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3	13	23	
4	14	24	
5	15	25	
6	16	26	
7	17	28	
8	18	29	
9	19	30	
10	20	31	

5. Conclusion

As this publication's authors we are proud of this collection of practical and inspiring cases.

Looking at the examples, it is clear that an educational evolution has already started. Projects are still small, generally not at the heart of the curriculum and only available to those students who are really motivated to follow these courses. A campus is not yet a Cradle to Cradle® world.

But things appear to be changing. With the introduction of competence-based education and didactical concepts like trans disciplinary education, some of the required changes have been made. Furthermore, a great deal of attention is being paid to solve environmental problems, especially in the technologically oriented programs. With these steps, we are a bit closer to an educational system that might enable mankind to create a better world. However, a lot still has to be accomplished and the next steps to focus on are:

- ① how to get from solving environmental problems to creating real and positive solutions that are good from the outset;
- ② how these kinds of educational systems should be made mainstream, and
- ③ cooperation– many initiatives are not connected and that is essential for reaching the ultimate goal of embedding Cradle to Cradle in education, at every level.

These steps can and will be made. Hopefully you are inspired to contribute to and to cooperate in the defined goal.

Month 11

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Literature

Braungart, M., McDonough, W. (2002)
Cradle to Cradle, Remaking the Way We Make Things.

Braungart, M., McDonough, W. (2003)
Intelligent materials pooling: evolving a profitable technical metabolism through a supportive business community.
Green@Work 20, pp. 50-54.

Braungart, M., McDonough, W., Bollinger, A. (2007)
Cradle to Cradle design: creating healthy emissions – a strategy for eco-effective product and system design.
Journal of Cleaner Production 15, pp. 1337-1348.

Mulhall, D., Braungart, M., (2010)
Cradle to Cradle Criteria for the Built Environment
Duurzaam Gebouwd, CEO media, The Netherlands

Notes

- 1 See also Michael Braungart's explanation of the differences in the Introduction
- 2 http://www.vangansewinkelgroep.com/library/VGWG_Jaarverslag-2009_ENGELS_Strategie_PAG_20-22_LR.pdf
- 3 <http://www.vangansewinkelgroep.com/en/company/CtoC-VG.aspx>, 30 January 2011
- 4 Code of conduct: <http://www.desso.com/DessoDocuments/brochures/Code%20of%20Conduct%20NL.pdf>, November 2010
- 5 One of the most important C2C innovations is the DESSO AirMaster. This carpet ensures that the fine dust concentration in the air is 8 times lower than with hard flooring solutions (PM10) which is considered to be a high level C2C innovation.
<http://www.desso.com/Applications/BusinessCarpets/NewProducts.aspx?cc=A886%204407>
- 6 http://www.desso.com/Desso/home/EN/EN-Cradle_to_Cradle/Cradle_to_Cradle_certification.html, 31 January 2011
- 7a <http://www.factoryofthefuture.nl/Brainstorm%20Factory%20of%20the%20Future%20Honours%20Programma.pdf>
- 7b <http://www.factoryofthefuture.nl/index.html>, 03 februari 2011
- 8 Michael Braungart's position on C2C in primary education is that it is too early in their lives to burden young children with the problems of the world. So any approach to C2C at this level has to be 'fun and games' and not scaring children about their future
- 9 www.irisz.me
- 10 www.duurzaamleren.org
- 11 See notes of the quality assurance editor in the previous paragraph on the 'zero'-terminology
- 12 See the Editor's note on page 34

Month 12

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Lighting products Biolux & Relux - Cradle to cradle design paradigm 1 (case study by Laurens Kemp & Pien ten Voorde, students)

Introduction

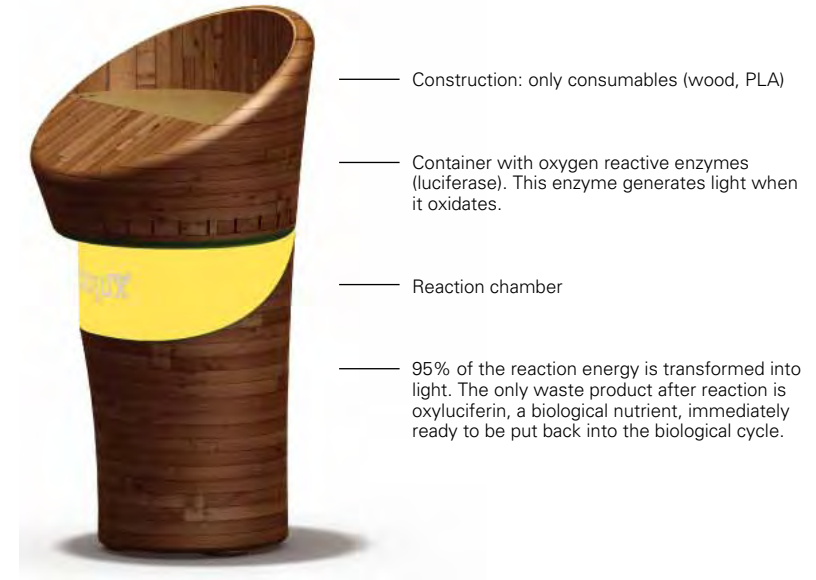
In the Cradle to Cradle design philosophy, the distinction between the biological and technical cycle is an important aspect. Therefore we decided that the design target for the assignment to make a cradle to cradle design product was to make two Cradle to Cradle lamps; one for the technosphere and one for the biosphere.

Design choice:

The choice to make a design of a lamp was based on the following pre-set objectives:

- Everyday use product;
- Small and simple product for practical implementation;
- Low complexity.

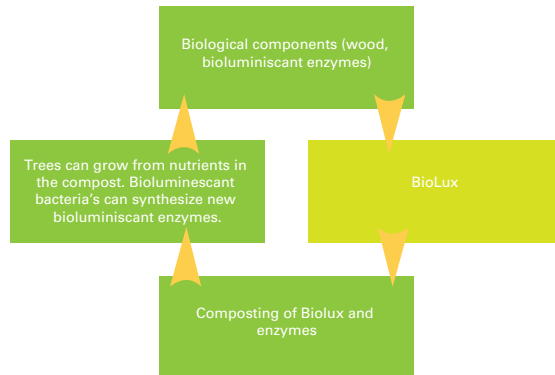
To make a clear distinction between the biological and technical cycle we decided to design two lamps. This way the differences and similarities can clearly be shown and it is a challenge to fulfill the same function within both cycles.



Description

The BioLux is completely made from biodegradable materials and can therefore completely return to the biological cycle. For the light source, bioluminescent enzymes are used so there is no need for an external electrical energy source.

Disadvantages of the lamp are that the light intensity is low and it is currently expensive to produce.



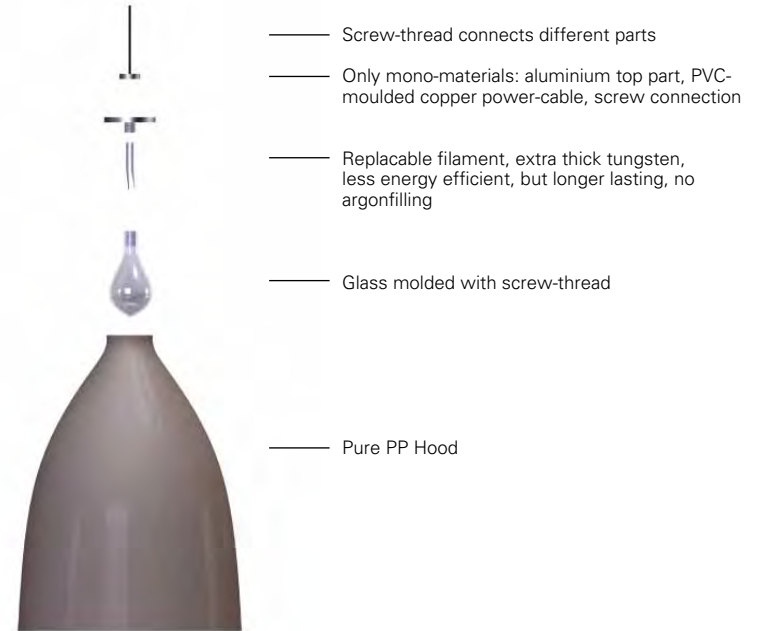
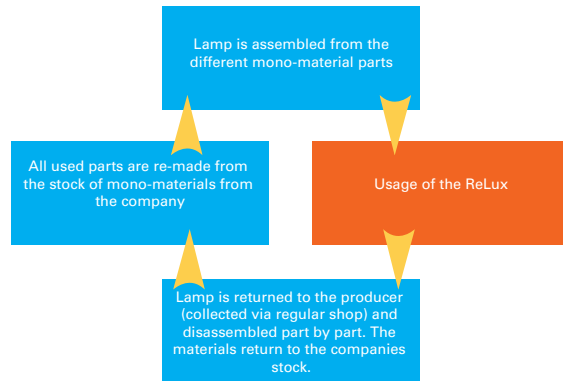
Conclusion

The design target to design a lamp for both the biological and technical cycle (respectively the BioLux and the ReLux) is achieved. When the two lamps are compared it can be concluded that the lamp for the technical cycle is more feasible than the biological lamp. The Relux can be produced using conventional methods; the production of the BioLux is more difficult because it uses new techniques. The marketing of the products should be aimed at the higher segment because the products are not (yet) competition for the conventional lamps. For further development both products have to be elaborated more to check whether complete.

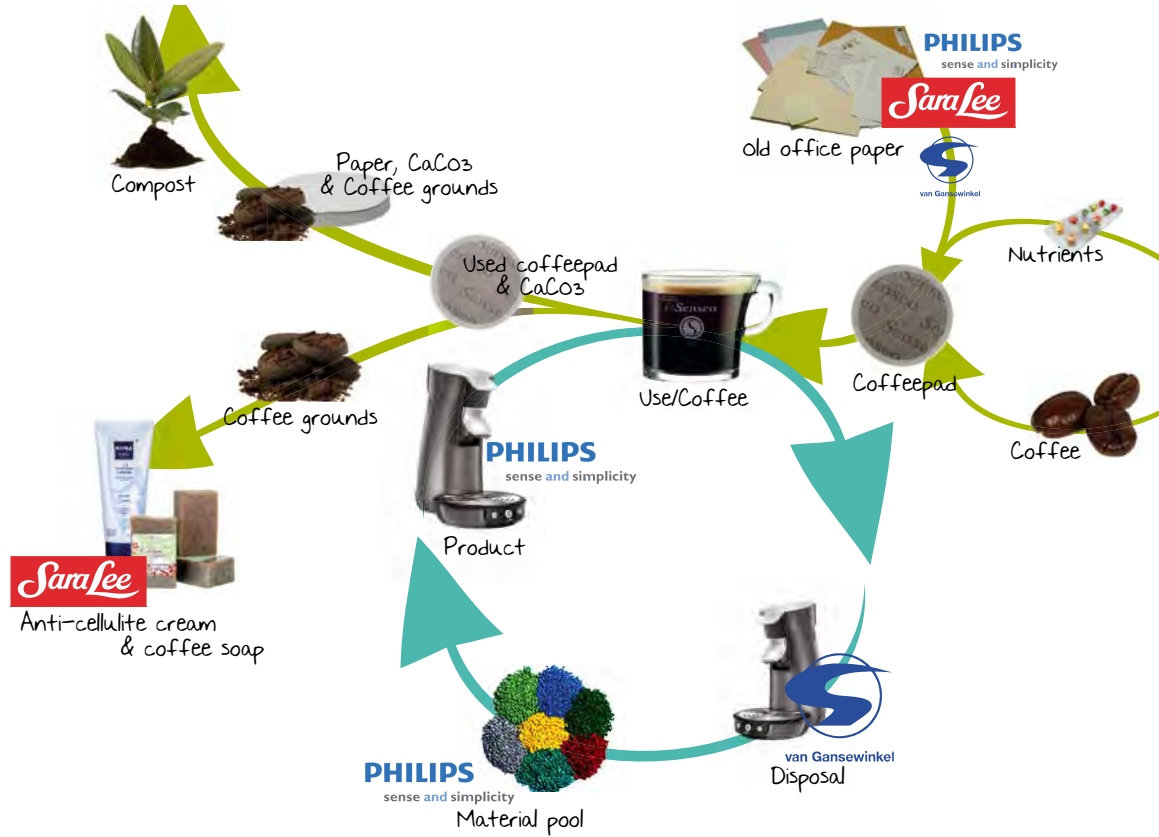


Description

All parts are made of “pure” materials, when properly disassembled 100% of the lamp is usable in new products. The ReLux is compatible with existing power outlets. Due to the thick tungsten filament, the lamp is not very energy efficient and there is much heat production. The lamp should be collected by the producer in order to disassemble it properly.



Coffee cycles (case study by Marieke Brouwer, student)



Colofon

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