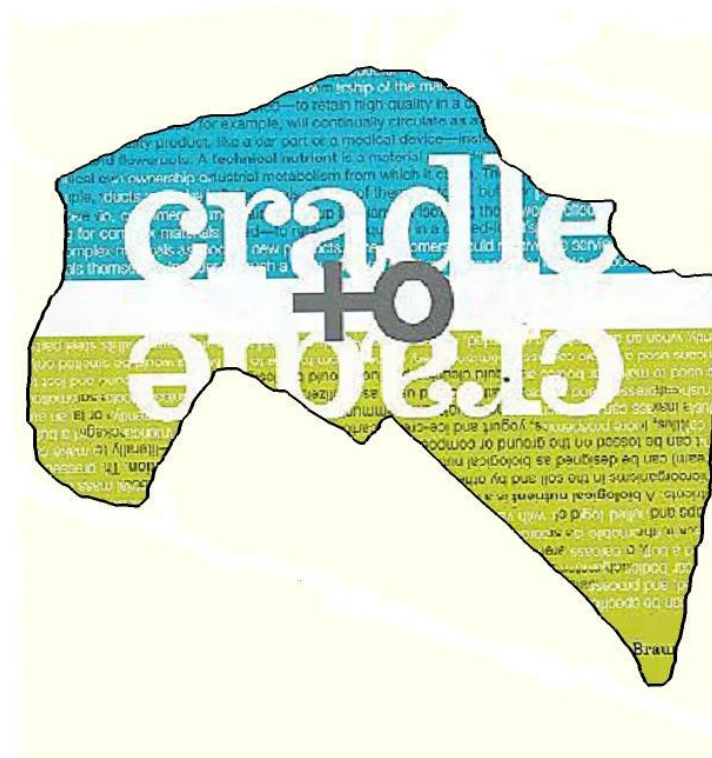# Applying cradle-to-cradle on the regional scale:
Spatial planning in the province of Groningen

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Masterthesis Environmental and Infrastructure Planning

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Preface

This masterthesis was written as part of the master Environmental and Infrastructure Planning at the University of Groningen. The research was supervised by dr. Nanka Karstkarel. I would like to thank her for her many constructive comments during the process of writing this thesis. Furthermore, the recommendations of my other supervisors, Ferry Van Kann, MSc, Prof. dr. Henk Moll (IVEM), and ir. Rob Roggema (Province of Groningen), have proved to be very helpful as well. The expert advice and comments of all these four people have taught me many things about doing research and writing scientifically.

Also, I would like to thank everyone else who has helped me with this research. Especially the province of Groningen and the municipalities of Venlo and Almere contributed substantially with their openness and hospitality. Cradle-to-cradle proved to be an inspiring and innovative subject, and I can recommend everybody to read McDonough and Braungart's 2002 book, or watch the Tegenlicht-documentary on the internet. The fact that various persons indicated to be interested in the final result of this masterthesis was another motivating aspect.

I hope that this research has produced a quality document, which hopefully will be very useful for Rob Roggema and his colleagues at the Groningen province and everyone else interested in the subject.

Enjoy reading my masterthesis,

Bouke Wiersma

August, 2008

List of Contents

List of Figures and Boxes

Abstract

This research focussed on the opportunities offered by the cradle-to-cradle (c2c) approach for sustainable spatial planning in the province of Groningen. C2c proposes to close material cycles by reusing every material indefinitely. C2c is unique in the enthusiasm it created in both economic and ecologic worlds. Venlo and Almere are among the regions which have adopted c2c within spatial development. Although in very early stages of implementation, these cases already make clear that the c2c approach should be transformed towards the area-specific needs. Also, Venlo is regarding c2c as an economical approach, while Almere considers it mainly as a sustainability concept, confirming the broad enthusiasm surrounding c2c. The policy of Groningen made clear that c2c is not part of their plans, while the approaches used did not resemble c2c philosophy either. Furthermore, the plan lacked a central vision which integrated the various parts.

In conclusion, c2c certainly offers opportunities to Groningen, as any approach creating this much and widespread enthusiasm would. Policy-related opportunities include the lack of an integrated vision, and adapting several existing policies. Area-specific opportunities did not fall within the scope of this research, however, the declining population could be an example. It is important for Groningen to adapt c2c to the area-specific situation, and find its own opportunities for c2c.

Samenvatting

In dit onderzoek is gekeken naar de kansen van cradle-to-cradle (c2c) voor een duurzame ruimtelijke ordening in de provincie Groningen. C2c is een nieuwe benadering van duurzaamheid, die een recente opkomst maakt in Nederland. De provincie Groningen staat bekend om haar duurzame ambities, maar de c2c benadering maakt hier vooralsnog geen onderdeel van uit. Dit onderzoek gaat verder in op de mogelijkheden die er eventueel liggen voor c2c in Groningen.

C2c, wat tegenover cradle-to-grave geplaatst kan worden, gaat om het elimineren van het concept afval. Afval zou volledig opnieuw gebruikt moeten worden in nieuwe producten: afval = voedsel. Alle gebruikte materialen moeten vallen binnen één van de twee kringlopen: alle hoogwaardige materialen in de technische kringloop, en alle biologisch afbreekbare materialen in de biologische kringloop. Het op deze wijze sluiten van materiaalkringlopen is een belangrijk punt van c2c.

Uit dit onderzoek zijn een aantal minpunten van c2c naar voren gekomen. De belangrijkste hiervan zijn het microniveau van c2c, waardoor problematiek van wereldschaal (klimaatverandering, sociaaleconomische ongelijkheid) onvoldoende wordt meegenomen, en als gevolg hiervan dat c2c niet duurzaamheid in zijn totaliteit omvat. Verder bleek dat de boodschap van c2c niet uniek is: diverse andere benaderingen propageren dezelfde principes, zoals het sluiten van kringlopen. Het bijzondere aan c2c is echter dat het een brug lijkt te slaan tussen economie en milieu. Het kan rekenen op enthousiasme uit zowel de bedrijfs- als de milieuhoek. Hiermee vormt c2c een belangrijke stap in het debat over duurzaamheid, waarbij economie en milieu niet langer lijnrecht tegenover elkaar staan.

Het kleine schaalniveau waarop c2c oorspronkelijk werd toegepast wordt verhoogd in de cases Venlo en Almere. Hiermee wordt tegemoet gekomen aan een aantal kritiekpunten op c2c, zoals de te kleine schaal. In deze regio's wordt de benadering gehanteerd als belangrijke leidraad in de ruimtelijke planning. Beide regio's zijn nog maar kort bezig met c2c, en weinig staat vast over de implementatie. Venlo kiest c2c met name vanuit economisch oogpunt, omdat de benadering financiële voordelen met zich meebrengt. In Almere, daarentegen, wordt c2c in de eerste plaats als een duurzaamheidsbenadering gezien, en speelt het met name een rol op milieugebied. Beide regio's zijn in het bijzonder enthousiast over de positieve aard van c2c, en zien kansen in het optimisme wat c2c losmaakt. Verder voeren beide regio's een aangepaste versie van c2c in; de benadering wordt veranderd aan de behoeften van de specifieke situatie. Zo wordt tegemoet gekomen aan het kritiekpunt dat c2c geen volledige duurzaamheidsbenadering is.

De provincie Groningen noemt c2c niet in haar nieuwe Provinciaal Omgevingsplan. Een deel van de doelen gesteld in dit plan lijken op het concept, maar de benaderingen die gebruikt worden verschillen sterk van c2c. Een ander opvallend aspect van het nieuwe POP is dat er geen centrale visie wordt gebruikt die terugkeert in alle deelaspecten van het plan. Er is geen

integrale benadering die verschillende sectorale visies verbindt. Dit biedt kansen voor c2c, omdat dat juist een integrale benadering is.

Dit onderzoek stelt dat c2c zeker kansen biedt aan de provincie Groningen. Een benadering die zoveel enthousiasme teweeg brengt in zowel het bedrijfsleven als in de milieuhoek, biedt altijd kansen. In dit onderzoek is alleen gekeken naar het beleid van Groningen en niet naar de regiospecifieke situatie, daarom kunnen met name beleidskansen geïdentificeerd worden. De voornaamste hiervan is het gebrek aan integrale visie in het POP. Dit is een perfecte mogelijkheid om het potentieel van c2c als positieve en integrale benadering te benutten. Daarnaast is de aanpassing of uitbreiding van bepaalde bestaande strategieën uit het plan ook een goede mogelijkheid.

De vraag waar de regiospecifieke kansen liggen, valt niet binnen het bereik van dit onderzoek. Gedacht kan worden aan energiepotenties of de krimpende bevolking. Het is in ieder geval duidelijk dat Groningen het c2c concept moet aanpassen aan de eigen situatie. Verder bezaten Venlo en Almere duidelijke redenen om te kiezen voor c2c: het is belangrijk dat Groningen ook haar eigen kansen vindt. C2c is tenslotte niet een doel, maar een middel om bepaalde doelen te bereiken.

Chapter 1: Introduction

1.1 Cradle-to-cradle

Sustainability is an increasingly popular theme. Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs (Brundtland, 1987). Ever since the rise of the environmental movements in the 1970s the emphasis has been shifting to a more thoughtful way of using resources and materials. Within the discipline of spatial planning attention is being paid to sustainability and the way to achieve it. Planners have over time adopted many approaches to realise their sustainable goals and one of the newest is cradle-to-cradle (c2c). This approach gained popularity following the release of the book 'Cradle-to-Cradle: Remaking the way we make things' by founders William McDonough and Michael Braungart in 2002. C2c has recently led to significant enthusiasm among Dutch policy-makers and businessmen because of its perceived innovative and unique contents.

In the book on c2c, the approach is positioned as opposing cradle-to-grave. This cradle-to-grave tradition is about the one-time-only usage of materials and resources. This way of producing dates back to the eighteenth-century Industrial Revolution and is particularly known for the linear use of materials; resources are extracted from the environment, utilized in a product, and eventually end up in a landfill, only to never be used again. Products are not designed for their components to be reused; those valuable components are lost when the product is thrown away (Figure 1.1). By throwing away the product, valuable materials and resources are lost for reuse, while used chemicals potentially harm the environment. An example of a cradle-to-grave designed product is a simple plastic bag; at some stores customers automatically receive a plastic bag to transport their purchased goods home. At home, the plastic bag is mostly immediately disposed of; the useful life of the bag is limited to the fifteen-minute trip home, while the valuable materials of which it was made were lost for reuse. Regarding more complex products, McDonough and Braungart (2002, pp.27-28) state: "It is often cheaper to buy a new version of even the most expensive appliance than to track down someone to repair the original item. In fact, many products are designed to last only for a certain period of time, to allow – to encourage – the customer to get rid of the thing and buy a new model."

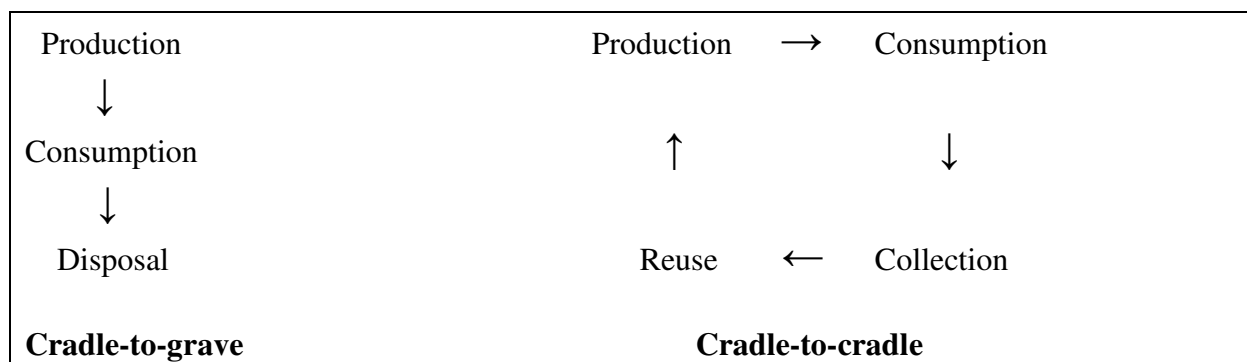| Production		Production	$\rightarrow$	Consumption
$\downarrow$				
Consumption			$\uparrow$	$\downarrow$
$\downarrow$				
Disposal		Reuse	$\leftarrow$	Collection
Cradle-to-grave			**Cradle-to-cradle**	

Figure 1.1   Cradle-to-grave versus cradle-to-cradle

C2c is proposed as a sustainable alternative to cradle-to-grave. In the c2c approach, materials and resources are used in such a way that they never have to be thrown away (Figure 1.1). All products should be designed in order to reuse the valuable materials by the manufacturer. Less valuable materials or simple products which do not necessarily have to be returned to the producer, such as the plastic bag, should be biodegradable. Use of harmful materials and chemicals is limited to a minimum, decreasing or even eliminating environmental damage. Another term synonymous for c2c is 'waste equals food', which generally means that all waste should be input ('food') for new products. High-value waste like copper becomes food in car-manufacturing, while low-value waste like biodegradable bags can be food for nature. Therefore, the concept of waste is eliminated, because what used to be waste is now considered food for new products (McDonough and Braungart, 2002). An example of a c2c solution for a cradle-to-grave problem is provided in Box 1.1.

A financially-troubled Swiss textile mill wanted to create an environmentally intelligent fabric. Government regulators had defined the mill's secondary products, the side-products which resulted of the production process, as hazardous waste, which therefore had to be exported to Spain for disposal, obviously an expensive solution. The company itself at first suggested combining a natural, biodegradable material with a recycled one; however, this still created a product which in the end only could be thrown away because it is neither fully biodegradable nor fully reusable. In short, the mill faced two problems: the end product was neither fully biodegradable nor fully recyclable, and the side-products which were created during production were dangerous to the environment.

The solution was found in the usage of a combination of plant and animal fibers for the fabric, and the right selection of dyes and other chemical elements. For the latter, eight thousand commonly used chemicals were ruled out because of their harmful effects on the environment, and only thirty-eight chemicals were deemed appropriate for the assignment. These solutions combined solved the forementioned problems and led to several additional advantages; the water flowing out of the factory was now cleaner than the water flowing in, the need for regulation was eliminated, rooms that were previously used for hazardous-chemical storage are now used for recreation or as extra workspace, regulatory paperwork was eliminated and workers stopped wearing protection masks. A fabric was created that after use could be safely be composted and provide nutrients for life elsewhere, while the mill started making profits again. (McDonough and Braungart, 2002)

Box 1.1   Example of a c2c solution

1.2   Cradle-to-cradle within spatial planning

Clearly, c2c is an approach with a micro-scale focus. Most problems dealt with are concerned with production and materials, as well as architecture. The impact of c2c on space, discussed in this paragraph, makes clear the need for integrating c2c and spatial planning. Other aspects become important, aspects which c2c did not include.

Within c2c, just as in planning, location matters. Cradle-to-grave does not pay attention to spatial differences and is choosing one well-known solution on most occasions, regardless of specific opportunities or hazards, and therefore results in many of the same solutions. In contrast, c2c regards spatial diversity as an opportunity for providing tailor-made solutions

which fit the local environment better than a cradle-to-grave solution would have done. Where cradle-to-grave opts for well-known, generic solutions, c2c chooses new, creative solutions. C2c accepts that generic measures are not always possible and therefore takes interest in the specific local situation to create new ones.

Also, the relation with land-use would change; c2c puts a greater demand on transport and recycling in order to reuse all the materials from products. At the same time, landfills, garbage burners and garbage heaps will not be necessary anymore. Generally, a c2c world results in changing land-use types, which alters the demands on spatial planning.

In this thesis the focus is on the regional scale and therefore is about the transformation of applying c2c on a micro-scale to applying c2c on a regional scale.

The reason for examining the possibilities of c2c on a regional scale rather than a micro, local or global scale is that the regional scale seems to be the level which offers most opportunities. In contrast, the local scale is too small to incorporate aspects like biodiversity, transport or water in the approach, and to utilize spatial differences, while the national scale is generally too large. For these reasons the regional scale seems to be the most appropriate level.

So far c2c has been applied to production and use of materials, but the application to regional spatial planning requires a transformation. The micro-scale orientation has to be changed because the level of scale of planning, which is bigger than just materials or buildings. Planning is about the environment at various scales, ranging from local to global, where more complex interactions play a role, especially when pursuing a comprehensive goal like sustainability. Aspects like transport, energy, water, biodiversity and location come into play on a regional scale. When c2c is to be used as a sustainability guideline on a regional level, these regional interactions should be given a place within c2c. Yet, c2c does not emphasise these aspects and therefore the concept has to be transformed to fit this new level of scale; emphasizing transport, energy, and other regional themes instead of materials and architecture only.

1.3   Casestudies

Within this research, the province of Groningen is the main area for which c2c possibilities are examined; the transformation of c2c to a regional scale is oriented to specifically fit this area. The province of Groningen is an area which has been concerned with sustainability for years. In the main provincial spatial plan, the 'Provinciaal Omgevings Plan' (POP, meaning Provincial Environmental Plan), Groningen defined sustainable development as the main goal (Provincie Groningen, 2006). The city of Groningen has adopted several policies to achieve sustainable goals, of which the best-known is the goal to be energy self-sufficient by 2025 (Gemeente Groningen, 2007).

Now the Groningen province is working on a new POP, it seems the right moment to include the upcoming c2c approach in plans and policies. However, considering the popularity of c2c it is remarkable that the province does not mention the approach in the new plan.

To be able to say something about the transformation of c2c from a material-based approach towards an approach fit for the regional level of scale, it is useful to examine some cases in the Netherlands where regions have already adopted c2c. Also, the way these regions are

trying to implement the approach will be discussed. Practical implementation of abstract theories like c2c can prove difficult, and therefore it can be useful for Groningen to learn from these cases. So far, two regions have publicly stated to use c2c for sustainable development: Venlo and Almere.

In 2007, the municipality of Venlo signed, alongside with several other parties, an agreement which states the intention to guide further development according to the c2c approach. In 2012 the Floriade, an international exhibition of flowers and gardening held every ten year in the Netherlands, will be organized by the city of Venlo and specifically for this event the c2c philosophy has been adopted. The area in which the event will take place has yet to be developed, and all of this development will be planned according to the c2c approach. Also, recently the city of Almere presented the so-called 'Almere Principles', which will act as a guideline for the development of the city until 2030. These principles are all about sustainable development and c2c. The Principles will make their way into all other municipal plans concerning development in this period, in which Almere has planned to double its population to some 350.000 inhabitants.

These cases should provide some answers on the extent in which c2c is applied at a higher level of scale, how to implement c2c in policy and to which regional processes, such as energy, transport or biodiversity, c2c is applied in Dutch practice. In some aspects, the province of Groningen case resembles the Venlo and Almere cases, however in other aspects there will be differences and therefore the results cannot be simply generalized. For example, the Venlo and Almere cases take place primarily at the local level, while the province of Groningen is representing the regional level, including not only urban but also rural areas. Hopefully, these cases will make clear whether c2c significantly contributes to sustainable development, and in such a way in which it is distinctive from other sustainability approaches.

1.4 Goal statement and research questions

The main goal of this research is to examine the theoretical and practical possibilities offered by the c2c approach for a sustainable spatial planning in the province of Groningen.
To clarify the research goal and the way in which the goal will be reached, this research is divided into a number of questions. The main question is:

What possibilities, from a theoretical and practical point of view, are offered to the province of Groningen by the cradle-to-cradle approach in order to achieve a more sustainable spatial planning?

Other questions which will be examined are:
- *What exactly is the cradle-to-cradle approach and how can the approach be positioned between other sustainability approaches?*
- *How has the cradle-to-cradle approach been put into practice elsewhere in the Netherlands?*
- *What can be learnt from these attempts with regard to implementation, the level of scale used, and the processes to which it is applied?*

- *To what extent is current Groningen policy related to c2c and which opportunities does it offer?*
- *What added-value does c2c have for the province of Groningen and how can the approach be successfully implemented?*

1.5   Methods

First of all, the concept of c2c will be thoroughly discussed in a theoretical manner; the 2002 book on c2c by McDonough and Braungart will be the most important source for this. In addition, some major criticisms expressed in newspaper and journal articles will also be reviewed. Furthermore, c2c will be compared to several established approaches of sustainability, which should answer the question whether c2c is really that unique and innovative as the recently emerged enthusiasm suggests. The comparison of c2c with these other approaches should create a clear framework which clarifies the position of c2c in the field of sustainability concepts. This way, the concept should become more clear and be provided with more perspective. Also, the theoretical possibilities for the transformation of c2c from micro to regional scale will be examined.

In the third chapter, the cases of Venlo and Almere will be used for learning purposes for the province of Groningen. Information on these cases will be derived from policy documents, interviews and the internet. The emphasis will be on describing the case, and examining the extent in which c2c is implemented; whether c2c is transformed beyond the micro-scale level, and which regional processes are included. Also, important will be to learn how these regions are trying to implement c2c; which opportunities and difficulties were encountered in implementation and how they where solved.

Following the casestudies, the current important policy of the province of Groningen is examined to find out which approaches to sustainability are used instead of c2c. The goal is to find out to what extent those approaches are comparable to c2c. It could be that Groningen already works with some aspects of c2c without referring to it as being c2c. In the theoretical chapter the extent to which c2c is unique was already theoretically examined, and this part of the research will provide additional practical answers to that question. The new POP will play an important role; the approaches to sustainability used in this document will be compared with c2c. Subsequently, possibilities for c2c with regard to implementation, regional processes and level of scale should become clear. Additional interviewing will complete the chapter on the province of Groningen.

Finally, theoretical and practical possibilities are reviewed and brought together in chapter 5. All information gathered previously will be combined here to answer the main question. Also, conclusions will be drawn, which will be shortly summarized in chapter 6.

1.6   Contents of this research

In this first chapter the design of the research was made clear. The following chapter, Theoretical Framework, will discuss the c2c approach more thoroughly and review some of the criticisms expressed. In addition, c2c will be compared to some other well-known approaches of sustainability in order to find out whether c2c is truly a new and innovative approach. Chapter 3 will deal with the cases of Venlo and Almere, where c2c is being put into practice at a level of scale higher than the original micro-scale. The province of Groningen

should be able to learn from these attempts. In the fourth chapter, Policy of the province of Groningen, the current policies of Groningen are discussed to find out which approaches to sustainability are used and how much the policies have in common with c2c. Chapter 5, Possibilities of c2c for the province of Groningen, will bring the information of these chapters together in an effort to answer the main question. Finally, chapter 6 will conclude with some last remarks and recommendations.

Chapter 2: Theoretical Framework

To be able to review the possibilities of c2c for sustainable spatial planning in the province of Groningen, it is important to fully understand this approach. This chapter will extensively elaborate on the c2c concept in a theoretical manner, including criticisms. Furthermore, other approaches to sustainability will be discussed in order to create a sustainability framework to position c2c in. The differences and similarities between those approaches and c2c will be emphasized. Moreover, possibilities for the transformation to the regional level and the role of spatial planning within implementation are reviewed.

2.1   Theory of cradle-to-cradle

The phrase 'cradle-to-cradle' was already invented in the 1970s, however it became popularized by McDonough and Braungart's book of 2002. This section will be largely based on this book, because it is the most comprehensive description of the approach.

C2c is essentially a concept which seeks to eliminate the concept of waste. The way by which this is done is to redesign production processes from cradle-to-grave to cradle-to-cradle. The incentive for this rethinking of production has been the enormous amounts of waste and pollution produced by society, combined with the depletion of resources.

Cradle-to-grave urges society to constantly search for new materials because the ones that were previously used were thrown away. To acquire these new resources far-reaching efforts with major spatial effects often have to be made, such as large-scale open-pit mining. What is called recycling actually is 'downcycling' because the materials used in the secondary products lose their quality as they are mixed with all kinds of other materials, eventually the only thing that can be made from those materials are cheap, low-quality products. A typical case of this loss of valuable materials is exemplified in Box 2.1.

> "Metals are often downcycled. For example, the high quality steel used in automobiles – high-carbon, high-tensile steel – is 'recycled' by melting it down with other car parts, including copper from the cables in the car, and the paint and plastic coatings. These materials lower the recycled steel's quality. More high-quality steel may be added to make the hybrid strong enough for its next use, but it will not have the material properties to make new cars again. Meanwhile, the rare metals, such as copper, manganese, and chromium, and the paints, plastics, and other components that had value for industry in an unmixed, high-quality state are lost. Imagine how useful it would be if industries had a way to recover that copper instead of constantly losing it." (McDonough and Braungart, 2002, pp. 56-57)

Box 2.1   Example of downcycling

These problems are solved by eliminating waste by design; waste no longer exists, because products are easy to deconstruct, valuable materials and resources are 'upcycled' and all other biodegradable elements are composted. This way, all of the materials used in products are useful after their life as a product is over, and no quality is lost.

C2c proposes the idea of all materials in the world belonging to one of the two production cycles: the technosphere or the biosphere. Technical nutrients, mostly valuable materials, are of use to industrial systems or technosphere, while all biological nutrients are of use to natural systems or biosphere. The problem of contemporary society is that both kinds of nutrients are mixed in such a way that neither of them can be reused. McDonough and Braungart coin the term 'monstrous hybrid' for such a non-reusable product. C2c proposes to redesign products so that they can easily be disassembled after use and all nutrients can safely return to the cycle to which they belong. This way, all nutrients can continuously be utilized and no quality is lost.

Despite all these positive ideas, implementation remains to prove a problem with regard to sustainability concepts. Regarding implementation, McDonough and Braungart (2002) have thought of the following distinction: eco-efficiency (related to cradle-to-grave) versus eco-effectivity (related to c2c). Both terms stand for ways in which sustainable development can be achieved; however there is an important difference. Eco-efficiency is about less consumption, decreasing ecological footprints and behaviour change, while eco-effectivity is advocating intelligent design and unlimited consumption. McDonough and Braungart regard the eco-efficiency approach as a negative one which makes people unhappy and even makes them feel guilty about living on earth and using earth's resources. A main problem with the eco-efficiency approach is that it maintains the cradle-to-grave production model, because while consumption has lowered, the products consumed have not changed at all. Therefore, pollution and resource depletion continues, only at a slightly lower pace, continuing the same problems.

Eco-effectivity is a fundamentally different approach. While eco-efficiency is about "being less bad", because the old cradle-to-grave model is maintained, eco-effectivity proposes a new strategy, abandoning the old model. This new strategy is c2c, which no longer puts limits on consumption, because consumption is no longer a bad thing. C2c is working on the right things instead of making the wrong things less bad (McDonough and Braungart, 2002).

Most contemporary solutions advocate behaviour change, aiming at the voluntary decrease of people's consumption. Therefore, they are generally eco-efficient. Government regulation, education, moral appeals; all of these can be called eco-efficient rather than eco-effective, because of their common purpose of behaviour change. In present-day society, these are the solutions which are heard most often. However, most people do not like it when they are told they should buy less, consume less, go on holiday less and take shorter showers. Luckily, according to the theory of c2c, these old-fashioned strategies are no longer necessary when c2c is put into practice. All products and services would be designed in such a way that they are harmless to the environment, and consuming them is no longer a bad thing.

McDonough and Braungart (2002, p. 16) use the analogy of an ant colony: "All ants on the planet, taken together, have a biomass greater than that of humans. Ants have been incredibly industrious for years. Yet their productiveness nourishes plants, animals and soil. Human industry has been in full swing for little over a century, yet it has brought about a decline in almost every ecosystem on the planet."
The point made here is that humans should design their environment like the ants do. Consuming no longer means damaging the environment but instead means helping it,

enabling plant and animal life to flourish. All 'waste' produced by an ant colony effectively is food for other natural processes, and therefore ants are not, like humans, a burden to the earth. Box 2.2 makes clear what possibilities of c2c are foreseen by McDonough and Braungart.

"Wouldn't it be wonderful if, rather than bemoaning human industry, we had reason to champion it? If environmentalists as well as automobile makers could applaud every time someone exchanged an old car for a new one, because new cars purified the air and produced drinking water? If new buildings imitated trees, providing shade, songbird habitat, food, energy, and clean water? If each new addition to a human community deepened ecological and cultural as well as economic wealth? If modern societies were perceived as increasing assets and delights on a very large scale, instead of bringing the planet to the brink of disaster?" (McDonough and Braungart, 2002, p. 90)

Box 2.2 McDonough and Braungart's enthusiasm

2.2 Critique on cradle-to-cradle

Two prominent critics of c2c are Martens and Amelung. They express some doubts regarding the c2c approach. One of their main concerns is that of the 'technological fix' (Martens and Amelung, 2007, 2008). C2c claims to achieve sustainability by simply improving technology, while not paying attention to other types of solutions to environmental problems, like increasing public awareness and changing individual behaviour. Focussing on only one of many solutions creates a problem when that one solution turns out to be less effective than expected. This especially applies to c2c, because of the comprehensive nature of the concept: essentially, the whole society will have to change dramatically, which obviously is quite an assignment. When this proves unattainable in practice, society depends on other solutions. It is not unrealistic that the suddenly appeared enthusiasm with regard to c2c will also rapidly fade away. In that case, not only the c2c world will not be realized, also people's attitude towards sustainable behaviour will not be constructive because c2c encouraged them to consume more instead of less.

Another assumption c2c makes is that all people can properly handle c2c products, while in reality many things can go wrong. Products will have a very specific destination after their use, but chances are they will instead end up at the wrong place or will simply be thrown away in nature. When all effort is directed towards a technological fix, and no attention at all is paid to raising environmental awareness, people will still be reluctant to pay any effort to solve environmental problems. Environmental negligence will result in people not caring at all for values of nature, using the right products but displaying the wrong behaviour.

Another point made by Martens and Amelung (2007, 2008) is that c2c should not be seen as the solution for all environmental problems: c2c does not equal sustainability. Problems such as material shortage and pollution can be solved. However, c2c does not pay attention to some other major contemporary problems posed by human behaviour, such as climate change, loss of biodiversity and wealth inequality. As long as there is no education and environmental awareness, these issues will not be considered important and therefore will not be resolved. The micro scale-oriented nature of c2c results in solutions which are sustainable in itself, but which are not necessarily sustainable at a higher level of scale. C2c as a concept simply can

not provide sustainability as long as these global issues remain untouched; sustainable development requires more than just c2c.

Furthermore, they argue that the concept of c2c is not fully thought through. McDonough and Braungart only asked the question of 'what', ignoring other questions like 'how much', 'where' and 'when'. This results in an incomplete image of the problems and the solution, because solutions that are found will not be considered completely, for example on aspects of quantity. Also, regarding material flows, some problems can be signalled. For example, supplies of waste should match the demand for food, but this match is unrealistic in both time and space. There is so much management to be done that this will prove expensive and complicated and will result in a suboptimal situation. Moreover, according to Martens and Amelung, supply and demand should fit exactly, which requires a great deal of planning in advance, described as an almost communist-like system. The question can be posed whether such a system fits our free market-economy. In our present-day system businesses can freely start to produce whenever they want to, but in a c2c world a businessperson first has to find out whether the required 'food' actually is available and whether the company will be able to get rid of its 'waste'. This would pose a serious restriction on business freedom and initiatives, which are essential market-economy features.

A final criticism ventilated by Martens and Amelung (2007, 2008) is the inevitable growth of the technological cycle compared to the biological cycle. This is the result of technical nutrients for which there is not yet an existing destination, or new product. For these materials new products have to be designed, and for these products the same thing has to be done. Therefore, the technical cycle will inevitably grow. Within the cradle-to-grave system, this growth was countered by burning the waste and getting rid of all kinds of materials. However, as within c2c waste is tried to be made useful, burning it is no longer an option. This results in a growing technical cycle, with an increasing number of technical nutrients in it.

Additional critical notes are provided by Van den Brand (2008). McDonough and Braungart do not use the concept Life Cycle Analysis, which deals with the interactions between product and environment throughout its entire life cycle. The emissions and raw material use which result from the production and life of a product are described. Also, the repercussions of these emissions and material use are mapped. Due to the lack of quantitative research done on c2c few actual numbers are known regarding c2c projects, and therefore essential facts are missing to properly discuss c2c as a tool for sustainability.

Moreover, Reijnders (2008) is questioning whether biodegradable materials are as good as Braungart et al. (2007) argue. Increased presence of certain nutrients such nitrogen and phosphate have resulted in 'algal blooms', which damage ecosystems. This is a current problem is the Netherlands, where fertilizers used in agriculture have resulted in increased amounts of nutrients in surface water. Also, increasing nutrient availability on land results in loss on plant diversity, because low-nutrient habitat disappears. Furthermore, the effects of the biological nutrient CO_2 are not necessarily good for both plant life and human conditions. In summary, contrary to what McDonough et al. (2007) suggest, increased emissions or wastes consisting of 'biological nutrients' are not ecologically irrelevant, and should be handled carefully.

The criticisms stated below were not discussed by the forementioned authors, but can also be added to the list of things which are not all that clear regarding the c2c approach.
It can be argued that the demand for transportation and energy will increase dramatically. The production, reclaiming, reshaping and reproducing will place a great demand on transport and energy use. The routes of materials in a cradle-to-grave system are fairly simple: from source to use to sink. C2c proposes a constant movement of materials from factories to households and back again. Household appliances like a television will be produced, used, and turned back to the producers, who will disassemble it and reuse some of the materials and ship some other materials to somewhere else, which again requires transportation. Transportation, production, disassembly and recycling require lots of energy, which makes this solution an expensive one.

Furthermore, it is unclear how the production of biodegradable goods will be realized. The c2c book admits it is not possible to produce all these new materials by agriculture. How these materials should be created instead is a question which remains unanswered. In examples like the one with the Swiss textile mill in Box 1.1, where wool is used as a solution, the material does come from agriculture and increased land-use. However, the limits of the amount of materials the earth's cultivated land can produce are becoming increasingly clear. When the world is 100% c2c, every biodegradable part of a product has to be made from something, and this will often be some kind of agricultural product. This means more competition for arable land and increasing food prices, which increases present-day problems in developing countries.

Another complication which can be mentioned is regulation. According to McDonough and Braungart, regulation is not needed when society is only producing good things: regulation will even form a barrier. However, one can never know for sure whether all people within society will cooperate. The assumption that all people will work together, sharing the same sustainable goals and ideology is a questionable one. In the past, the usage of harmful materials has not halted until government regulation appeared. As long as it remains profitable to use harmful and valuable materials in an unsustainable way, this continuously will be done.
A question related to these aspects of regulation is whether companies will decide to switch to c2c. The traditional goal of most companies is maximizing profits, not to achieve a sustainable world, and therefore sustainability needs to become profitable. Companies are unlikely to change their production processes to c2c as long as this does not increase profits. Some examples of McDonough and Braungart have showed that c2c solutions can increase profits while at the same time being sustainable. However, these examples mostly have a relation with government regulations; it was because of government regulation that the production processes became expensive. In Box 1.1, the regulation required extremely safe storage of chemicals or the transport to a far-away recycling plant. When these regulations would disappear, companies could create their own, cheaper solutions for dealing with hazardous chemicals. Shortly put, when regulation simply disappears, as is advocated by McDonough and Braungart, the economic incentive for using c2c will largely disappear, because c2c no longer increases profits, but also the use of hazardous toxins and valuable materials is likely to increase, resulting in even more pollution. Also, not all production

processes will be cheaper when c2c is used: complicated processes using hazardous materials, are more likely to be made cheaper by c2c than fairly simple production processes.
The criticisms mentioned in this paragraph are summarized in Box 2.3.

Criticisms on c2c:
- Problematic 'technological fix'
- C2c does not equal sustainability
- C2c is not fully thought through
- Inevitable growth of the technical cycle
- No quantitative research has been done on c2c
- Biodegradable nutrients can be problematic
- Great increase in transportation and energy demand
- Problematic mass production of biodegradable goods
- Without regulation, environmental damage will increase
- Without regulation, c2c is not financially attractive

Box 2.3   Summary of c2c critique

2.3   Critique review

In summary, there is a lot of criticism concerning c2c. However, not all concerns expressed are equally relevant. In this paragraph the criticisms mentioned in Box 2.3 will be reviewed.

A major criticism on c2c is the problematic emphasis put on the technological fix. This criticism seems to have a point; the emphasis put on the technological fix is dangerously ignorant of other solutions, and the critics do have a point in questioning the fact that all effort is directed to only one solution: what if that solution fails? Of course it is most convenient for society to continue consuming at high rates while hoping for a technological fix, but it would be rather stupid to be lacking a plan B. There is no assurance that technology will come up with some great earth-saving solutions. Therefore, governments could for example aim their efforts towards other solutions implementing behaviour change such as education or tax measures, in addition to the technological fix.

It is also clear that c2c does not provide a comprehensive solution. It partly neglects major problems such as climate change, global wealth inequality and loss of biodiversity. In the case of loss of biodiversity, c2c does not specifically argue for conservation and protection of valuable areas, but the concept does involve creating liveable environments for both humans and other species. In a c2c world, streets would be filled with trees, and roofs would be covered with grasses and other vegetation, so c2c does pay attention to wildlife and habitats, but not in the traditional, conservative manner. Regarding climate change, c2c clearly argues in favour of using renewables like solar and wind power. The emphasis of the approach simply is on material use and design, therefore paying somewhat less attention to other aspects of sustainability, but this does not mean that the approach completely ignores those aspects.

The argument that c2c is not fully thought through is somewhat cynical. The approach indeed did not consider every possible aspect, but the examples proved that it is possible for c2c

solutions to work in the real world. Moreover, the claim that within c2c supply and demand will have to fit exactly, has unclear foundations. Within the contemporary market-economy, supply and demand do not fit exactly either. Instead, c2c aims to use and stimulate the market-economy as much as possible. For example, the required 'food' and 'waste' of c2c companies are valuable materials, and therefore there will nearly always be a demand for these materials. Most companies will use their own waste as food, so there is no need at all for complicated quests to find a suitable waste destination.

Also, the match between supplies of food and demands for waste, in both time and space, is questioned. However, within the present cradle-to-grave system, this match might just be even worse. For example, oil is produced in the Middle-East, than transported to Asia for the production of plastic goods, which are transported to Europe, where they are burned after use. Clearly, in this situation the demand for plastic goods in Europe can be fulfilled by shipping products over great distances. In a c2c situation, the demand for these plastic goods still exists, but instead it is fulfilled by locally present materials, being plastic goods which are already present in Europe. This match seems to fit better both in space and in time.

The claimed inevitable growth of the technical cycle is only mentioned very briefly by Martens and Amelung (2007, 2008). The fact that some nutrients do not yet have an existing function as input in some new product is presented as a problem. However, this can also be seen as an opportunity for the creation of new and innovative products. Also, when c2c should be fully integrated in the technical cycle, all waste has been food in an earlier stage, meaning that all materials in use already experienced the entire cycle, and thereby proving their qualities as food. In that case the technical cycle will not grow at all, because for every material there will be an existing new destination. This point of critique is not really aimed at c2c, but rather at the situation of transformation from cradle-to-grave to c2c, when some traits of cradle-to-grave (the use of hardly reusable materials) still remain. Therefore, the growth of the technical cycle is not inevitable, it is temporary.

The fact that no quantitative data is known for c2c solutions, compared to other possible solutions, can be considered a problem. Still, it only remains a problem until someone performs this quantitative research to find out more about c2c. It is clear that c2c becomes improved when more is known about its quantitative effects.

Also, the point that biological nutrients are not ecologically irrelevant should be taken into account. A large amount of nutrients can surely damage the environment, and can not always be carelessly thrown into nature, as was proposed by McDonough and Braungart (2002). Regarding biodiversity, it is important to maintain habitats for species dependent on a low-nutrient environment.

The increased demand c2c will place on transport and energy is evident. The question is how society will deal with this; when energy production continues to produce CO_2, c2c will create even more climatic problems. Conversely, when solar power is used, c2c will contribute to solving the problems of climate change. The same accounts for increased transport: this opens up possibilities to create new types of clean, sustainable transport, but it also contains the risk that simply more cars and other petrol-fuelled vehicles will be used. This all depends on how

society chooses to implement c2c; especially the scale which is used. On a global scale, the transportation of 'food' and 'waste' across the globe requires huge amounts of energy. Here lies a justification for the use of c2c on the regional scale, a scale on which transportation is a less problematic and expensive aspect.

An important role can be distinguished for spatial planning. Locating the suppliers and demanders of 'food' next to each other can greatly decrease the demand on transport. So, when waste equals food becomes a starting point within spatial design, transport demands can be much less urgent.

The problematic production of biodegradable goods is a problem that yet has to be solved. When everyone is applying c2c, the demand for biodegradable goods will increase significantly. Clearly, this situation will place a great demand on land, and it can be imagined that even more forests will be replaced by farms to meet the supply. Also, competition for land with food producing agriculture could increase food shortage problems. McDonough and Braungart (2002, p. 42) admit that it is not possible to produce all materials by agriculture: "If several billion people want natural-fiber blue jeans dyed with natural dyes, humanity will have to dedicate millions of acres to the cultivation of indigo and cotton plants just to satisfy the demand – acres that are needed to produce food."

Also, the aim of abolishing regulation is not the most feasible feature of c2c. Without regulation, there is the risk of companies using hazardous chemicals on a large scale resulting in major environmental damage. The financial incentive for implementing c2c by companies largely disappears in the absence of regulation. Also, complete disappearance of regulation is not a target which makes an approach sound more realistic, even though it might create some opportunities for creative and new solutions.

Finally, the problem of c2c being a micro-scale solution resonates throughout most of the criticisms. For example, the use of agricultural land for the production of biodegradable goods is likely to create problems for the production of food for the continuously growing world population, and important global issues like loss of biodiversity and global economical inequality remain mostly untouched. But where the emphasis of c2c mainly is on materials and production, this certainly does not mean that other issues of sustainability are completely neglected.

In a recent interview in newspaper *De Pers*, Braungart clarified some things by stating the following: *"It is not about everything being perfect. I'm not perfect myself. (…) There will always be products containing heavy metals. It is about us performing an intellectual exercise in order to design products which do the least possible amount of damage, and even design products which eventually are the beginning of new products."* (Mohamedjoesoef, 2007). Braungart puts the approach in a finer context here: it is not about the whole world becoming c2c, it is more about rethinking the world around us. Therefore, critiques stating that a c2c world is unrealistic are somewhat less important, because that wasn't the original goal of c2c either. So, it has became all too clear that regarding sustainability c2c in itself is not sufficient. It will be necessary to combine c2c with other approaches to sustainability to overcome the micro-scale and partial nature of the c2c concept.

2.4   Other approaches resulting from the concept of sustainability

A common criticism is that c2c is not new; it clearly is the result of earlier approaches of sustainability (Mahoney, 2005). While the resemblance with other approaches is not necessarily a bad thing, it is also unsurprising, considering that most approaches share a common goal: sustainable development. Although many definitions of sustainable development exist, many approaches sharing similarities have emerged. One of the best-known definitions, also used in this research, is: development that meets the needs of the present without compromising the ability of future generations to meet their own needs (Brundtland, 1987). In this paragraph some prominent approaches aiming at sustainability will be discussed and compared to c2c, in order to find out how c2c can be positioned between other sustainability approaches. First of all, two approaches related to parts of c2c will be reviewed, and secondly two other approaches which are more comprehensive, similar to c2c, are discussed. This paragraph does not have the intention of being a complete summary of existing sustainability approaches. The purpose of reviewing the following approaches is to clarify the position of c2c between other approaches, to find out what distinguishes c2c from existing approaches.

The first approach which resembles a certain part of c2c is behaviour change, or eco-efficiency. Where c2c tries to realise sustainable development by relying on a technological fix, the opposite is to rely on behaviour change. McDonough and Braungart (2002) reject behaviour change, which they call eco-efficiency, and propose eco-effectivity as an alternative, as was explained in paragraph 2.1.1. While opposing each other, both are indeed ways to realise sustainability. Gardner en Stern (2002) mention four approaches to changing individual behaviour: laws and regulations, education, informal social processes in small groups or communities and use of moral, religious or ethical appeals. Most of these approaches are regularly encountered in everyday situations, as efforts to change individual behaviour. Clearly, behaviour change is the opposite of c2c, which does not advocate any of the four options offered above. Instead, c2c claims that individual behaviour does not need to change at all; consumption can even increase. Because no attention at all is paid to other possibilities, both approaches can be considered as extremes on a spectrum (Figure 2.1).
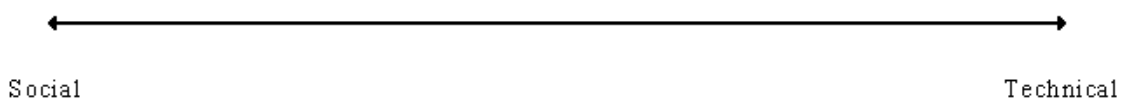
Social   Technical

Figure 2.1   Spectrum of social and technical extremes

Another aspect of importance within c2c is waste management. C2c aims to eliminate waste by cleverly designing our environment. However, c2c is not the only approach proposing a change in waste management. McKinney en Schoch (2003) describe three main paradigms which have been dominant over time: dilute and disperse, concentrate and contain, and resource recovery. For most of human history, wastes were disposed of by a 'dilute and disperse' strategy. Early gathering and hunting cultures simply left trash where it fell on the ground and moved on. This paradigm lasted until the early twentieth century, when its practical limits became clear. The capacities of ecosystems and sinks were reached and surpassed, and natural systems were damaged due to the massive amounts of waste dumped

into them. The new 'concentrate and contain' paradigm constituted of collection of trash and the permanent isolation from the environment. This paradigm resulted in sanitary landfills and hazardous and radioactive waste disposal sites. One of the problems accompanying this paradigm is the artificial and hazardous nature of modern wastes which require extremely safe storage, which is hard to accomplish. Another problem concerns the question whether it is fair towards future generations to remove valuable materials and change them into hazardous or toxic wastes which never can be used again. These problems resulted in the third paradigm, 'resource recovery', which aims at reducing or eventually eliminating waste. Waste is first reduced at the source, and after the designated use all remains are reused or recycled. McKinney and Schoch (2003) indicate that present-day society has a long way to go before this actually is accomplished. While the concentrate and contain paradigm is similar to the cradle-to-grave approach, the resource recovery paradigm resembles c2c; both aim to eliminate wastes and call for a major change in the technology of manufacturing. C2c is one of the possible strategies within the resource recovery paradigm.

Some concepts which are equally comprehensive as c2c will now be discussed. The first is the Trias Energetica concept, which may be a specifically energy-targeted concept, but can be applied on a range of other aspects, for example ecology, which has its own 'Trias Ecologica' (Van den Dobbelsteen, 2008), or mobility (Van Kann and Leduc, 2008). Generally, Trias Energetica, involves three statements on sustainable energy use (Van Kann and Leduc, 2008):

1) Prevent energy use as much as possible
2) Use renewable resources
3) Use all resources as efficient as possible

The sequence of these steps is very important, because the main goal should be to prevent energy use as much as possible. This prevention should not be done by behaviour change, but instead by design. The second step involves using renewable energy sources such as solar and wind power to fulfill the remaining energy demand. Last of all, all resources should be used as efficient as possible. This mainly applies to the present-day situation where the use of fossil fuels is dominant; specifically those resources should be used as efficient as possible.

This concept greatly resembles c2c, as all three statements also apply to c2c. A difference is that c2c is mostly about materials, where Trias Energetica is about energy; of course it is possible for materials to maintain a high quality, while energy will lose its quality when used. Still, both approaches use the same principles of clever design and efficient use of available resources, therefore Trias Energetica can be seen as the energy-related application of c2c.

When the Trias Energetica concept is put into practice, one of the possible results is the cascading approach, which is the practical form of point three of Trias Energetica: the efficient use of all resources. Cascading is about optimizing flows by strategically locating its users. For example, when trying to minimize energy use, cascading can be a guideline. Electricity plants using fossil fuels produce much excess heat, which can be used by neighboring greenhouses and any remaining heat can be used in offices and residential areas. The temperature of the waste heat is highest in the top of the chain, because industry needs these high temperatures rather than households. This is worked out in Figure 2.2, where the arrows represent a certain amount of waste heat, and the feedback loop represents for example waste such as biomass, which can be turned into heat. Each sector receives some waste heat in exchange for their waste. The total demand for energy within the chain represented in Figure

2.2 will be decreased, limiting both costs and CO_2 emissions. Moreover, the approach can also be applied to materials and resources, where the feedback loop should ensure the reuse of materials, which means closing the cycle the same way as it is done within c2c.
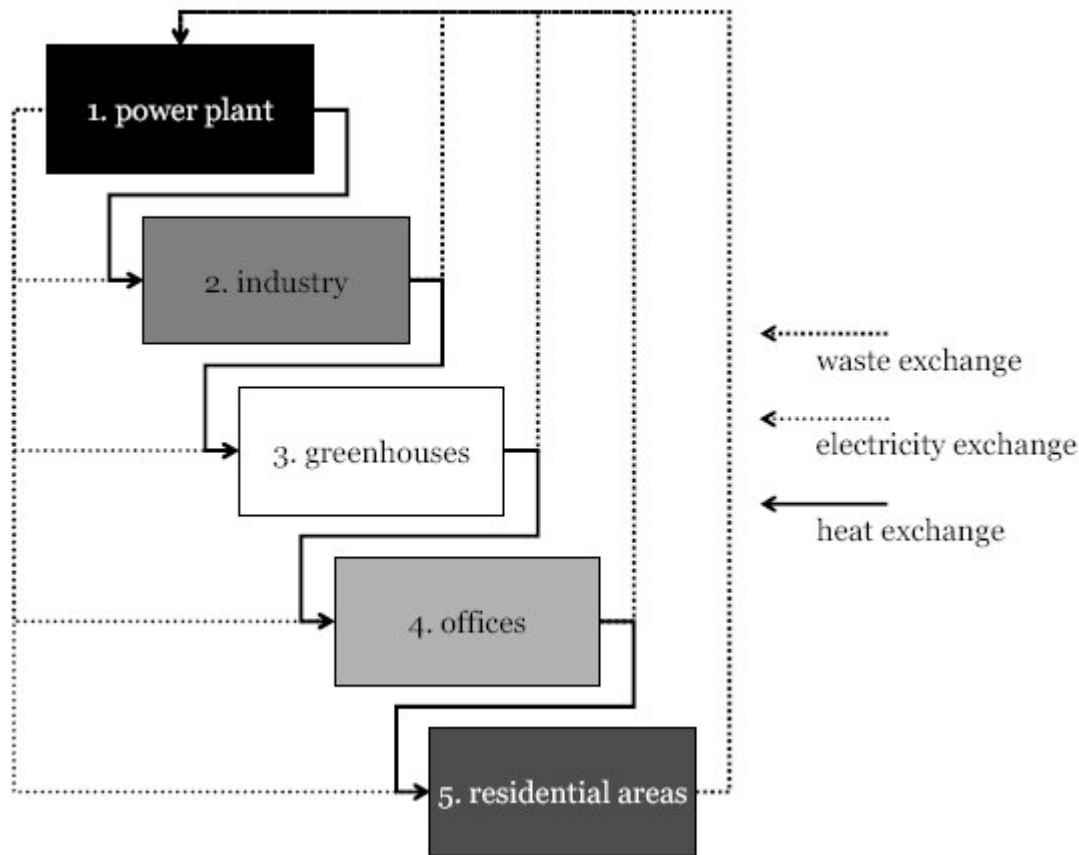
Figure 2.2   Cascading waste heat (from: Van Kann and Leduc, 2008)

It is important to involve feedback within this approach. When this would not be done, the remaining approach would be linear, which results in loss of quality; one of the main criticisms of c2c. Within the energy cascading example, a feedback from some heat-receiving sectors could be created in the form of biomass: the biomass produced by some activities can be transported back to the electricity plant, where new electricity can be generated from it. Cascading is quite similar to c2c in the way 'materials' such as energy, are optimally utilized.

In conclusion, it becomes clear that c2c is not new and unique, as some authors already concluded. C2c shares clear similarities with the sustainability approaches discussed above. Of course, the survey of approaches above is not complete, but the correspondence between those approaches and c2c make sufficiently clear that c2c is not unique, and that several other approaches advocate similar solutions.

However, one of the things which is unique for c2c is the enthusiasm that it brought about. The reason for this is obvious; there is something in it for everyone. Companies are promised higher profits, consumers are offered boundless consumption, and for the government c2c at last brings sustainable development: everyone's goals are fulfilled. Looking at it this way, it is no surprise that the approach received such positive comments from diverse areas of interest.

According to the critics, however, these claims made by c2c will not turn into reality. Companies will not necessarily increase their profits, infinite consumption will not become possible, and sustainable development will not be reached, for reasons mentioned earlier in paragraph 2.2.1. Nevertheless, the enthusiasm has not disappeared, and that alone is quite an accomplishment. Few approaches have managed to make sustainable development look so attractive. So far, other approaches mostly opposed economy and ecology as two polar extremes which could never be united, obviously a message which was both depressing and destructive for cooperation between both sides. Although already in 1987, with the definition of sustainable development by the UN mentioned earlier in this paragraph, there was an attempt to unite economy and ecology, c2c is the first practical approach which comes close to uniting these both worlds (Van den Dobbelsteen, 2008). C2c "generates a synergistic relationship between ecological and economic systems - a positive recoupling of the relationship between economy and ecology" (Braungart et al., 2007, p.1338). Indeed, c2c has in practice recently managed to raise enthusiasm in both worlds, and although not completely new, that alone makes the approach valuable.

2.5 The relation between cradle-to-cradle and spatial planning

The enthusiasm surrounding c2c has, as already mentioned in chapter 1, led several regions to adopt c2c in policy. In chapter 3 some of these regions will be further examined. These regions aim to implement c2c in all kinds of policy fields, including spatial planning. This research continues exploring the possibilities of c2c for a sustainable spatial planning, in the province of Groningen. When spatial planning and c2c are integrated, it is important to understand the relationship between c2c and space. In paragraph 1.2 some characteristics of this relationship were already briefly mentioned. In this paragraph the spatial aspects of c2c and the relation with planning come to the front more extensively.

The relation between c2c and space is primarily illustrated by three aspects: diversity, location and land-use. An important spatial aspect of c2c is the way in which is dealt with spatial diversity. Cradle-to-grave, opposing c2c, generally ignores differences and uses the same universal solution at every location, regardless of any specific opportunities or hazards ("culture of monoculture", McDonough and Braungart, p. 33). In contrast, c2c tries to optimise custom-made solutions by looking for those specific opportunities or hazards ("respect diversity", p. 118). Therefore, where cradle-to-grave would have created many of the same solutions, c2c would have provided different tailor-made solutions which optimally fit the local environment. McDonough and Braungart (2002, p. 30) refer to this particular aspect of the cradle-to-grave system as using 'brute force'; when the solution does not fit, simply try harder by using even more brute force. Cradle-to-grave is about making the environment fit the solution, instead of making the solution fit the environment. Cradle-to-grave solutions are designed with no regard to the natural situation and the natural forces; like they are completely cut off from nature. While in fact, it becomes increasingly clear that present-day society interacts with the environment in numerous ways. It is necessary to realise these interactions and begin to create a world that takes into account these interactions with the environment.
So, c2c is paying attention to spatial diversity in order to optimize solutions. This emphasis on spatial diversity also implies that location plays a greater role within c2c than within cradle-

to-grave. C2c is about an optimal relationship with the local environment, and this can be achieved even better by rightly choosing the optimal environment.

The third important aspect of the relation between c2c and space is land-use; the impact of c2c on land-use is significant. The demand for land may increase due to increasing demand for biodegradable goods, as was already indicated in paragraph 2.2.1. Also, the type of land-use will change as a result of c2c. The need for constantly mining new minerals disappears; damaging practices like open-pit mining or the extraction of minerals by using hazardous chemicals are no longer needed, because society does not constantly need more and new materials anymore. Also, the c2c model claims to solve the waste problem. Waste does not have to be burnt anymore, a practice which used to release dangerous toxins into the environment. Furthermore, the storage of hazardous waste, linked to the inevitable risk of leaking toxins into the environment, is not necessary anymore. Where waste disposal and burning does not use (and contaminate) land anymore, c2c puts some other demands on land-use. All materials constantly have to be retraced, recycled and redistributed, which means a greater demand on transport and more land for industry for the disassembly, storage and reuse of materials.

Moreover, c2c does not only affect space, the implications also make their way into existing spatial planning practice. When all production and consumption becomes clean and healthy, a promise of c2c, this will have some important implications for spatial planning. The former assumptions do not necessarily fit within the new c2c society. McDonough and Braungart (2002) discuss the possibility that industry becomes clean, which means no longer using hazardous chemicals in dangerous, toxin-emitting processes. This means it will not be needed any longer to strictly separate industrial and residential land-uses; the concept of zoning will not be needed anymore. Also the concept of the compact city can be reconsidered. This concept aims at concentrated city development rather than outward expansion, in order to optimize collectively used functions such as public transport, and to save landscape and open space outside the urban area. C2c could create cars that will not produce unhealthy emissions or use non-sustainable fuels, and therefore the need for public transport becomes less urgent. Also, the expansion of city borders will not be a bad thing because there will be a place for nature within the urban system. Environmental planning will have to be reconsidered because many of the things which were previously labelled dangerous or bad, have become good in a c2c world. Regulation on all kinds of emissions, such as particulate matter and NOx, will lose their urgency, and resulting spatial measures will not be needed any longer. Costly Dutch urban problems such as the shutdown of inner-city construction activities due to exceeded particulate matter-norms could be history. Also, the transport of hazardous chemicals by rail will not result in building restrictions anymore. The nature of spatial planning could change radically; from restrictive to non-restrictive, because the reasons for the limitative nature have disappeared. Although the specific Dutch situation still requires planning because of the limited space available, spatial planning will noticeably shift paradigm.

In the previous paragraph it has become clear that c2c is not new and unique, and when applying it to planning this conclusion is confirmed again. For a great deal, c2c falls within the framework set by three major influential paradigms.

First, the shift from 'toelatingsplanologie' (permission planning) to 'ontwikkelingsplanologie' (development planning) (De Roo and Voogd, 2004), also applies to c2c. This shift represents a radical change. Permission planning means regulative and restrictive planning, based on limitations, strict rules, and goal-maximization; the most important thing is to realize the goal which was set in advance. Development planning is about dynamic and specific planning, which involves stakeholders, communication and is based on process-optimization; the most important thing is a good process, rather than simply realizing the goal. Therefore, the change caused by c2c towards more freedom, creativity and development fits the new development planning approach perfectly.

The second major paradigm which also applies to c2c is the 'gebiedsgerichte aanpak' (area development approach), which emphasizes integration of all sectoral aspects, such as transport, water and biodiversity. It is somewhat similar to the development planning approach outlined above, yet the important emphasis within the area-oriented approach is on the regional level, and the integration of functions on this level. The approach emerged as a response to the situation in which all aspects were handled separately (De Roo and Voogd, 2004). It should ensure that all various aspects are successfully integrated. The resemblance with c2c lies in the way c2c is integrating all kinds of aspects, such as energy, material use and fauna habitat.

Third, c2c is a very postmodernist approach, in the diversity and creativity which it advocates. Within postmodernism, contrary to modernism, creativity and diversity are also important, rather than monotony and efficiency (De Roo and Voogd, 2004). C2c is very clear in rejecting efficiency and embracing creativity, which is reflected in the way it deals with spatial differences; postmodernist, c2c design involves creatively designing specific solutions, resulting in a diverse world.

All of these three influential planning paradigms also fit the c2c approach, just as they have shaped present-day spatial planning. While again showing that c2c is not entirely new, these similarities at the same time offer opportunities for a smooth implementation of c2c within spatial planning.

2.6   Implementing cradle-to-cradle

Now the relation between c2c and both space and spatial planning is clear, it is important to elaborate on implementation of the approach. Two main problems arise when considering c2c as a guideline for regional spatial planning: the level of scale and the practical implementation of c2c. These two aspects are essential to consider in order to successfully implement c2c.

As was previously indicated in paragraph 2.2.1, the scale on which c2c is implemented is very important. Transportation of materials all across the globe is not entirely sustainable. The integration of food and waste should be organized on a smaller scale in order to be fully sustainable. This is important to minimize transport efforts, and related energy-use. This is a justification for the use of the regional scale rather than the local or the global scale, which was also already explained in paragraph 1.2.

It has become clear from the theory of c2c that the approach is very micro-scale oriented. The emphasis is on production processes, design, materials and architecture. Some of the critics argued that the approach does not consider issues relevant at a higher level, like climate

change or biodiversity loss. Also, specific regional aspects are not really part of c2c; it wants to use the right materials, create healthy products and buildings, but nothing is said about regional aspects like transport. The problem with this is that as long as c2c is used only on a micro-scale and project-based, there is no guarantee that important regional processes are involved and integrated. C2c could create a world full of independently designed buildings, each unrelated, and of which the accumulated effects are unknown. Sustainability cannot be achieved by micro-scale solutions only, there has to be some kind of higher level coordination, in this case on the regional level. This way, the incorporation and integration of regional and national interests like transport and biodiversity are secured.

Transforming c2c to a regional level means adapting the basics of the concept to existing processes and interactions on the regional level. It is here where the link between c2c and spatial planning becomes clear: these are aspects which are generally managed by local and regional planning. Spatial planning will not only have a role in coordinating various, unrelated micro-scale c2c initiatives, it also involves transforming regional processes to c2c. Issues which were not mentioned by c2c, like transport and energy, should also become c2c. Regional spatial planning will have an important role in the realisation of this.

Next to choosing the appropriate level of scale, one other thing is very important when reviewing the possibilities of implementing c2c: the several strategies which are used to realize implementation. One main aspect of spatial planning is intervention, and although intervention is something quite contrary to c2c, when making an effort to use c2c within planning it is important to consider the possibilities for intervention.

De Roo and Voogd (2004) provide a spectrum on intervention, within which they distinguish three general types of intervention which can be used to implement c2c (Box 2.4). First of all, direct intervention stands for laws and regulations. Secondly, indirect intervention involves tax privileges, disadvantages or incentives. And thirdly, self-reliance means education and learning. These three types of government intervention can be used when trying to implement c2c. The three types differ from an important role for the government (direct intervention) to a very small government role (self-reliance). Varying situations call for varying measures, so these types of intervention will be used in all kinds of different situations.

Intervention strategy	Practical example
Direct intervention	Laws, regulations
Indirect intervention	Tax privileges, disadvantages, subsidies
Self-reliance	Education, learning

Box 2.4   Three different intervention strategies

When applying these intervention types to some aspects of c2c, they can be further explained. For example, within a c2c world all products will have a very specific destination after their useful lives, and there will always be a risk that the products do not reach this end destination. When the message is carried out that people do not have to care about the environment anymore, people will not be willing to make an effort in order for their product to reach the intended end destination. This makes clear that some education will be needed for this aspect. Incentives and tax disadvantages can be needed to encourage companies to start using c2c for their production processes. Laws and regulations can be useful in forbidding certain

hazardous products to be used, which act as an incentive to use environmentally friendly substances.

Clearly, c2c is not yet an approach which is all clear and ready to be implemented. Regarding the comprehensive nature of c2c, which leaves room for many things to be filled in more specifically, this uncertainty surrounding c2c is not surprising. It can be very useful to consider how c2c has been put into practice elsewhere before dealing with c2c in the province of Groningen. In the next chapter the cases of Venlo and Almere, which have adopted c2c as a guideline for development, will be examined. These cases should provide some learning points for the province of Groningen.

Chapter 3: Casestudies Venlo & Almere

It has become clear that c2c is a comprehensive approach to sustainability which offers possibilities but which also receives criticism. The fact that Venlo and Almere have adopted c2c as an important guideline within policy implies that despite all critique c2c nevertheless is an attractive approach for sustainable regional development. Yet, some aspects of c2c are not directly suitable for the use of c2c on a regional scale; in paragraph 2.2.1 some of these aspects were already discussed. Among the most urgent of them are the micro-scale and partial nature of c2c. In this chapter the cases of Venlo and Almere are studied in order to find out how c2c is implemented. This is mainly done by interviews, and also some policy documents are used in addition. Special attention will be paid to the particular aspects which were previously mentioned in chapter 1: how c2c is implemented, which intervention strategies are used, at which level of scale it is implemented, and to which processes it is applied. Also, the role of criticisms in the implementation of c2c is considered for both cases, by comparing the criticism summary of Box 2.3 with the related practical measures taken in Venlo and Almere.

In this research Venlo and Almere (Figure 3.1) are considered regions. Both are in fact cities, however Venlo combined with the surrounding municipalities is regarded as representing the regional scale. Almere does not cooperate very closely with surrounding municipalities, but it is an important part of a regional concept called the Noordvleugel ('Northern Wing'). Therefore, both cases seem to offer a good example of c2c on the regional level, or at least above city level. Whether c2c is actually transformed to this regional level is a question which has to be answered in this chapter. The case of Venlo will be examined first, because Venlo is the region which can be considered the pioneer of c2c in the Netherlands. It was the first to publicly adopt c2c and is currently the farthest in the process of implementing the approach.

Figure 3.1   Location of Venlo and Almere within the Netherlands

3.1 The Venlo case

3.1.1 Cradle-to-cradle in Venlo

First of all, it is relevant to discuss the basics of c2c in the Venlo region. Venlo is a city of about 90.000 inhabitants, located in the southern part of the Netherlands, within the province of Limburg (Figure 3.1). C2c made a start in Limburg in May 2007 during a c2c workshop about the Floriade horticulture show. This is an international exhibition of flowers and gardening which is organized every ten years, and hosted by Venlo in 2012 (Provincie Limburg, 2008a). The company organising the Floriade, Floriade BV, alongside with the Venlo region (a cooperation between Venlo and four adjacent municipalities), the province of Limburg, and the Chamber of Commerce agreed on presenting Limburg and Venlo as a sustainable region based on the principles of c2c. This resulted in the Floriade Venlo Principles (Box 3.1), formulated in cooperation with Braungart, one of the founders of the c2c approach. C2c will be applied on all practical matters of the 2012 Floriade, such as the development of the area, the buildings, but also everything related to the major event itself (Provincie Limburg, 2008a).

> Our mission is to use our Cradle to Cradle framework as an engine for innovation.
> Our Cradle to Cradle framework means:
> We are native to our place
> Our waste = food
> Sun is our income
> Our air, soil, and water are healthy
> We design enjoyment for all generations
> Our goal is a delightfully diverse, safe, healthy and just world, with clean air, water, soil and power – economically, equitably, ecologically and elegantly enjoyed.

Box 3.1   The Floriade Venlo Principles (Floriade, 2008)

As indicated above, next to the Floriade, several other projects are planned to be developed according to the c2c principles. Many of these projects fall within the Greenport Venlo area, an area without clear and fixed borders, where various kinds of projects take place. These projects are initiated and managed by the several municipalities involved. Whenever a new project is proposed, it is possible to add this to the Greenport Venlo region. Many different developments were taking place in this region when the parties involved realized that cooperation would have added-value, which resulted in the Greenport Venlo project (Boer and Vermeulen, 2008). Greenport Venlo is located to the northeast of the city of Venlo. The Venlo region is an important agricultural and logistical centre and the Greenport Venlo is aiming at specifically strengthening these functions. Turnover in this area should double to two billion euros due to the substantial ambitions (Greenport Venlo, 2007). Cooperation exists between all municipalities which are involved in Greenport Venlo, the national government, the province of Limburg, and some private parties.
There is quite a range of different names, areas and projects involved within the c2c activities within the Venlo region, which can be confusing. In short: the main area of c2c implementation is Greenport Venlo, which is shown in Figure 3.2. One of the projects within Greenport Venlo is Klavertje 4, an area of about 5.100 hectares. Klavertje 4 can be seen as the physical heart of the Greenport area. The Floriade 2012 will take place within Klavertje 4, on

a larger businesspark named GreenPark. So, Greenport consists of several projects, among others Klavertje 4. One of the projects developed within this area is the businesspark named GreenPark, which will host the 2012 Floriade. After the Floriade event has taken place, the area will become a regular c2c businesspark, just like the rest of the GreenPark area.
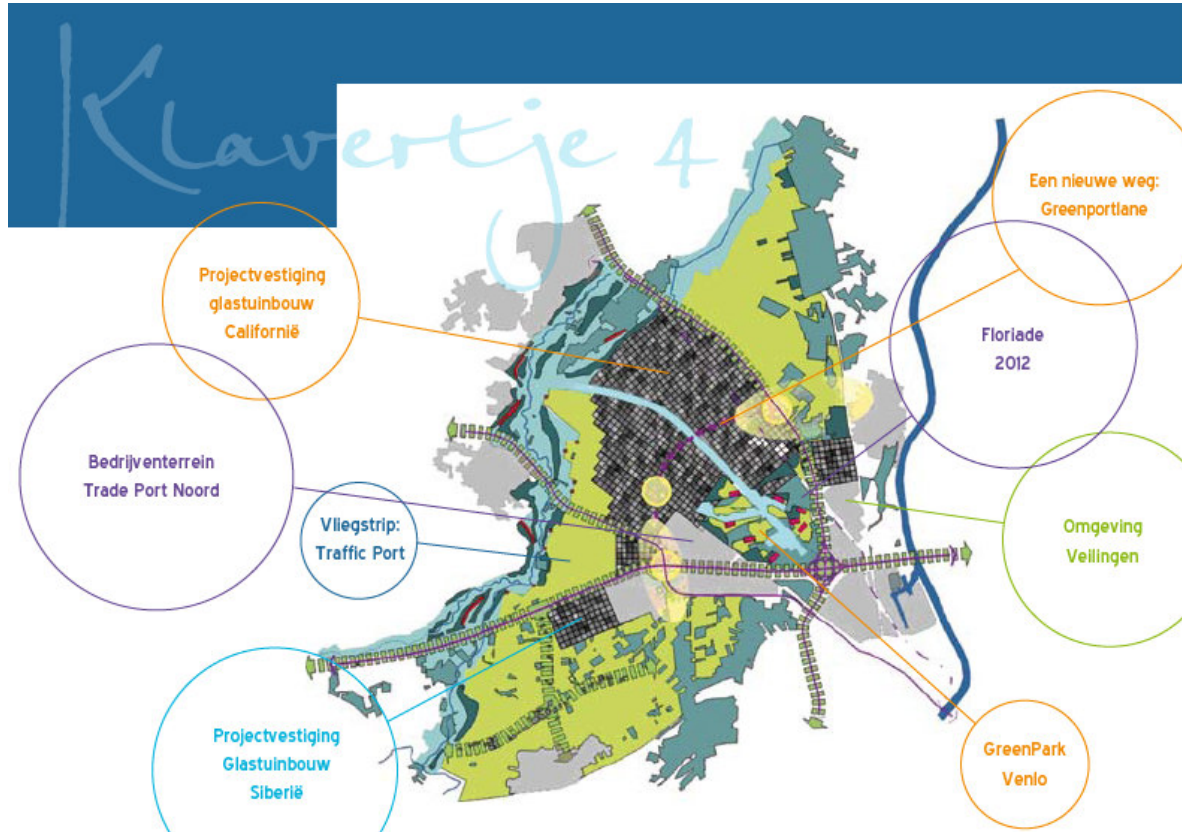
Figure 3.2   Overview of projects within Greenport Venlo (Greenport Venlo, 2007)

Next to the Greenport activities, both the Venlo region and the province of Limburg are making an effort to get c2c started in their areas. The reason for primarily examining the region of Venlo in this research rather than the province of Limburg, which is more similar to the province of Groningen, is that Venlo currently leads the field of Dutch c2c efforts. The province of Limburg is less far in the implementation of c2c and therefore offers less learning opportunities regarding the way c2c is put into practice. Nevertheless, the role of the province will be discussed to some extent in this paragraph.

According to Lukassen, coordinator of c2c activities within the municipality of Venlo (Appendix A), the prime incentive for the municipality of Venlo to adopt c2c was the economic advantages offered by c2c. This represents an approach opposite to the way how c2c has been discussed in this research so far. Even though c2c can be considered both an economic approach and a sustainability approach, in this research so far c2c was primarily elaborated on from a sustainability point of view. After all, the main goal is examining the possibilities of c2c for a more sustainable spatial planning. Venlo, in contrast, considers c2c primarily as an economic approach. This is exemplified by the fact that the alderman responsible for economical issues is the main person advocating c2c on behalf of the Venlo

municipality, rather than the alderman who deals with the environment. Also, the involvement of the Chamber of Commerce rather than an environmental agency is remarkable.

According to Lukassen, the activities surrounding c2c within Venlo are organized around three main themes: the built environment, businesses and education.
First, the built environment concerns the Floriade area and the larger business park named GreenPark, which accommodates the 2012 Floriade. Both of these areas will be developed in a c2c manner, together with the Klavertje 4 area. The Masterplan Klavertje 4 will elaborate on how to implement c2c in this area.
Moreover, the municipality of Venlo itself needs to provide some c2c examples, to strengthen the c2c message they want to spread. Lukassen states that this is needed to prove they are a reliable partner. The new building accommodating the Venlo government will for example be designed according to c2c. On more municipal c2c projects has not yet been decided, due to the short period of time since the adoption of c2c; some internal discussion on this will have to take place first.
The efforts related to business activity, the second theme, are primarily organized by the Chamber of Commerce. They provide businesses with information and workshops on c2c and work on spreading enthusiasm, so that business themselves will decide on switching to c2c. The incentive for them is mostly economic benefits offered by c2c, however the fact that they engage in ecological production may also attract more customers. Some of the entrepreneurs also adopt c2c out of ethical reasons. Efforts are furthermore aimed at creating a c2c business community, a network in which c2c companies can benefit from each others presence.
Moreover, Lukassen stresses that the effort to create c2c businesses is limited to stimulating and educating. There are no restrictions saying that only c2c businesses can establish themselves in Venlo, or tax advantages offered to c2c companies. The role of the government is mostly to facilitate and to create c2c opportunities by making contacts, trying to bring in flows of (European) subsidies, and by creating 'soft infrastructure'. However, this could change in the near future when more policy on c2c will emerge. It is not unlikely this will contain some advantages for c2c companies, such as privileges on location choice. An important difference between these municipal efforts and the Floriade, is that the Floriade can count on a major investment by the Province of Limburg when the event is actually developed in a sustainable way (Provincie Limburg, 2008a).
The third theme surrounding c2c in Venlo is education. The main goal is to preserve the knowledge within the region and to embed c2c within the region, and the main means will be the establishment of an academy degree on c2c. One of the founders of c2c, Braungart, will also be included in this institute. Moreover, contact was made with some local cultural institutions in order to incorporate some young and creative people in the process; not only would this involvement increase local awareness, it also can supply the c2c process with the much-needed creativity and enthusiasm. Secondary schools also deal with c2c, in order for the approach to be well-known within the Venlo population, something which is not yet the case. So, an effort is being made to include people from different angles and with different opinions.

The overall main goal of this adoption of c2c is, according to Lukassen, growth. This term can be interpreted as widely as possible: economic growth, development, sustainable growth, growth of the natural environment. This broad growth serves to create the picture of being an

attractive region, for both working and living. This goal is remarkably similar to the goal of c2c itself; the common growth of economy, ecology and consumption. Therefore, it is not all that surprising that the region is using c2c to achieve it.

Finally, it is relevant to note that c2c is not yet part of all regional plans. It is an official basic principle of the Floriade, and is part of the plans for GreenPark and Klavertje 4. However, it has not been laid down in official Venlo plans; but in the near future the approach will also be made part of the plans of Venlo. C2c is going to be an integral part of environmental policy and will also be a guideline within the Venlo regional cooperation. Whether c2c will be the central and most important vision of the region will be subject to some discussion within the municipality, it could be that some other major aspects will also be stated as starting points for development, for example the region being a centre of greenhouse agriculture activity.

3.1.2   Greenport Venlo

From this basic summary of c2c activity in this region it has become clear that not only the municipality of Venlo is working with c2c, some other regional parties such as adjacent municipalities and the Limburg province share this ideology. The Venlo region is willing to make an effort to successfully implement c2c. It is now interesting to examine how the region is trying to realize the c2c goals and ambitions. As mentioned earlier, special attention is paid to the regional processes on which c2c is applied, and to the level of scale on which c2c is implemented.

The Floriade Venlo Principles, which can be considered the start of c2c within this region, were agreed on in May 2007. From that moment until now, little over a year has passed and that has not been enough time for regulation to arrive; not much official regulation has been laid down yet. Therefore, it is somewhat difficult to review the way this region is implementing c2c. Only one plan exists which has proceeded a little further, and that is the Masterplan Klavertje 4. This plan is not yet confirmed as well, but it is expected to be completely finished by October 2008 (Greenport Venlo, 2008). This Masterplan comprises of several parts, of which the most relevant part right now is on spatial design. This part offers some insights in the practical implementation of c2c within the Klavertje 4 area. It is also the basic guideline for other more detailed plans which deal with all relevant aspects such as water and energy. These detailed plans, and other parts which are planned to be part of the Masterplan Klavertje 4, are not finished yet. So, the spatial design will be the most important source on c2c implementation in the Venlo region.

The spatial design plan was initiated by a wide group of parties: the local municipalities of Venlo, Horst aan de Maas, Sevenum and Maasbree, alongside with the province of Limburg, the national government (ministry of agriculture, nature and food quality), and several corporate partners. The goal of the cooperation of Greenport Venlo is: *"to develop the vast area into a dynamic zone of logistics and agricultural activity without causing irreversible damage to the environment in which these activities are embedded. The new buildings have to be integrated in the landscape in order to create a harmonic and sustainable equilibrium within the fusion of economy and ecology"* (Greenport Venlo, 2008, p. 6).

Seven basic principles are mentioned within the spatial design plan, which act as a guiding perspective for the development of Greenport Venlo. There are no clear and strict goals, for the plan mainly aims at displaying how the region could develop the coming decades. The seven main principles are shown in Box 3.2.

1) Spatial framework: Infrastructure and landscape are the spatial carriers which ensure enough accessibility and quality of life on the long-term, while at the same time offer enough flexibility for the (market-driven) fill-in. Creating space for doing business.
2) Minimizing the amount of traffic necessary. Optimal fine-tuning between various links in the agro-business will be spatially facilitated. Main infrastructure located near traffic-intensive functions.
3) The Klavertje 4 area is maximally energy and water self-sufficient. Facilitating cooperation with regard to energy, water provision, and with processing of waste materials and waste water.
4) Sense of place: creating an attractive environment (green&urban) to work and recreate. Seize opportunities regarding spatial quality in order to differentiate and create a Klavertje 4 identity.
5) Intensive use of space; multiple use of space and optimal use of collective facilities.
6) Connecting the area with existing ecological systems (EHS and more). Enlarging habitat for flora and fauna (and human).
7) Klavertje 4 in the larger context: involve adjacent areas and systems of larger level of scale in the design. Vice versa relate the programmatic meaning of Klavertje 4 to the surrounding environment.

Box 3.2   The main principles of Greenport Venlo (Greenport Venlo, 2008, p. 22)

Next to offering a long-term picture, the plan also offers the first 'building blocks', in order to be able to make a start and prevent having to wait for 25 years for the first visible result (Boer and Vermeulen, 2008). These blocks are the practical result of the efforts to create a c2c area. The smallest of these blocks is the four-leafed clover (Klavertje 4), which is displayed in Figure 3.3. Around ten of these clovers are planned to be realized adjacent to a new road, the so-called Greenportlane. This lane is planned to connect two important highways which cross the Greenport area, and plays a central role in the Klavertje 4 development. The exact route is not yet known, which exemplifies the early phases of implementation of the region. Due to the great amounts of traffic expected on this road it will consist of four lanes. Possibilities for the road to be constructed lower or higher than the local surroundings are kept open. This could minimize noise and pollution nuisance.

As was mentioned earlier, Greenport Venlo is an area with much horticultural and logistic activity, and the goal is to increase these activities. The Klavertje 4 plan is mainly aimed at the logistic sector, for the greenhouse agriculture sector is facilitated elsewhere in the Greenport area. The four-leafed clover is considered as offering an optimal solution for logistic businesses. These companies require enormous storage facilities, which need large amounts of space, and this is offered by the clovers. Shortly put, "the clover is the basic shape which enables realizing c2c goals" (Greenport Venlo, 2008, p. 41).

Figure 3.3 explains more on the four-leafed clover solution. At the bottom of the picture the Greenportlane has been drawn, which is surrounded by these clovers. One clover is displayed

on Figure 3.3, connected to the lane by a roundabout. On each of the four leaves, marked by the white space, room is available for businesses, especially logistics. According to Van Geenhuizen, involved in the development of Masterplan Klavertje 4 (Appendix B), the size of the leafs is specifically designed to ideally fit the room required by the logistical sector. Each leaf has a minimal surface of 200 by 200 meters, which offers room for four companies. Therefore, every four-leafed clover consists of a minimum of 16 hectares of company space, as well as several more hectares which are used for other purposes, such as water storage and infrastructure. All by all, each clover has a minimal size of about 23 hectares. The maximal size had not yet been determined in detail, yet it could stretch to about 100 hectares.

The details for this solution will be discussed according to five aspects, which are the same five aspects which the Greenport plan clearly defines: infrastructure, water, energy, habitat and green environment (Greenport Venlo, p. 8).
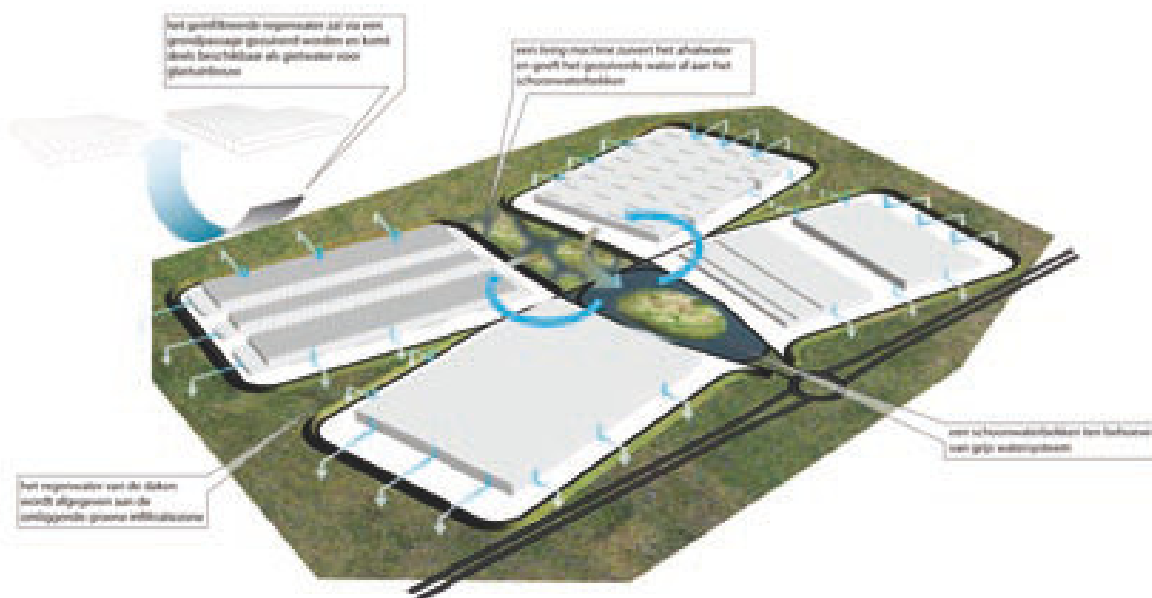
Figure 3.3   The four-leafed clover solution (Boer and Vermeulen, 2008, p. 6)

First of all, the plan involves specific infrastructural measures. The leafs are surrounded by roads which are confined to one-way traffic, in order to minimize asphalt demand, and optimize clarity and safety. Also, all locations within the clover can be reached optimally by bicycle. Within the space available for businesses, all companies face outwards, so all companies have optimal access to the roads. The leafs are connected in the stem of the clover, where the roads come together. All representative and collective functions, such as offices and restaurants, are located within this stem. Within the stem the road system is provided with a loop, so that both people who have taken the wrong turn and public transport busses do not have to follow the one-way traffic system all the way around. So, the bus stop will be located in the middle of the clover, which enables the busses to continue their route efficiently and minimizes the distances for employees.

As can be seen on Figure 3.3, the stem involves a pond, which plays an important role. The first role of this small lake is related to water management. The pond regulates peak discharges of rainfall, by offering room for storing the great amount of water which falls on the building's roofs. Furthermore, the pond cleans waste water from the surrounding

buildings; both water from toilets and water used in production can be safely stored in this water. It also awards a positive image to the companies, and it enables a diverse plant life. Within the whole Greenport region, the existing natural water system will be respected. This means creating possibilities for water to infiltrate the soil naturally rather than creating surface runoff resulting in water pollution. Practical solutions for this natural retention are green zones for infiltration of water into the ground, and creating green roofs; roofs covered with grassy vegetation (Greenport Venlo, 2008).

Next to these aspects of infrastructure and water, attention is also paid to energy. The heating system of the buildings will be connected to underground heat storage and to the local horticulture sector, in order to use waste heat. A series of windmills will be placed alongside a local railway track, which has been calculated to be the optimal location for windmills. Moreover, a collective biomass plant will be shared with other clovers and local energy users. Within this plant, waste biomass from horticulture greenhouses, pig manure, and green waste from the landscape and local villages will be used to produce energy. Also, the design of the buildings enables reduction of energy use. This could result in a 90% decrease of CO_2 emissions, and when the biomass plant is realized it could make the area produce no CO_2 at all. However, these solutions combined are very expensive, and therefore maybe not all of them will be realized at once (Greenport Venlo, 2008).

On the aspect of habitats for flora and fauna the Greenport plan involves some measures as well. It has become clear that the pond in the middle of the clover provides a habitat in offering room for plant diversity and water animals. Also, the clovers will be surrounded by a 'green belt', providing more room for plants and animals. The national ecological network, EHS (Ecologische Hoofdstructuur), has to be realized partly on the Greenport area due to national regulation, and some 400 hectares of nature will be added to this voluntarily by the Greenport Venlo organisation. Furthermore, the plan explicitly states that the existing green framework will be structuring the landscape (Greenport Venlo, 2008, p.8). This means that no rigid adaptations are made on for example the route of small streams. Also, the forementioned green roofs of the buildings serve as a habitat for plants and birds as well, next to being a water storage resulting in smooth infiltration.

Finally, the green environment is the last of the five points discussed in the spatial design plan. By green environment is meant that the area will be covered with nature and vegetation, in order to create an attractive environment in which working and living is pleasant. This green environment comes to the front throughout the four other points; green roofs, a small lake, and green belts all contribute to the green qualities of an environment which is nice to live in.

The first two subparagraphs of this chapter have shown how Venlo is making an effort to implement c2c. The goals and ambitions of the region have been reviewed, and also the more specific practical implementation has come to the front. The questions posed in the introduction of this chapter have been answered. Now it is interesting to further examine the Venlo case on the basis of another source of information. In chapter 2 the most important criticisms were discussed, and this can help to improve the understanding of the Venlo case. After all, chapter 2 proved that c2c was not an approach which offered a clear-cut, well-known path towards a certain future. The way Venlo deals with the various criticisms provide more evidence on how exactly the approach is used. Later on in this chapter, the same will be done for c2c applications in Almere.

3.1.3   Venlo's response to cradle-to-cradle criticisms

In paragraph 2.2.2 a summary was given of criticisms on c2c, and this creates a great framework for analyzing the Venlo case, and how they deal with the difficult aspects of this approach. In Box 3.3 this summary of critique is repeated, however it is supplemented with the response of the Venlo region. First, all of the ten points of critique will be mentioned, and Venlo's response will be shortly explained.

An important starting point of understanding the way Venlo considers c2c and its possible drawbacks is presented by Lukassen (Appendix A). She describes the way Venlo deals with c2c as "pragmatic"; the concept is mainly used as an economic incentive, and all environmental benefit it may bring is considered only a bonus. The region wants to take advantage of the enthusiasm surrounding c2c in order to make a change, to make something happen, and to create a region which is attractive. "Criticisms are not very interesting, we will see what happens", seems to be the main idea. Keeping this in mind, the ten points of critique will now be examined from Venlo's perspective.

Criticism	How Venlo deals with it
Problematic 'technological fix'	Combine with social solutions
C2c does not equal sustainability	Interpret c2c in a wider sense
C2c is not fully thought through	Ignore
Inevitable growth of the technical cycle	Ignore
No quantitative research has been done on c2c	Perform research
Biodegradable nutrients can be problematic	Ignore
Great increase in transportation and energy demand	No need for dealing with it
Problematic mass production of biodegradable goods	Ignore
Without regulation, environmental damage will increase	Maintaining regulation
Without regulation, c2c is not financially attractive	Maintain regulation while stimulating c2c by education and possibly by other means

Box 3.3   Criticisms and Venlo's response

Four of these ten points can be reviewed very briefly; Venlo generally ignores these criticisms (Box 3.3). These four include: c2c is not fully thought through, the inevitable growth of the technical cycle, the problems caused by biodegradable nutrients, and the problematic production of biodegradable goods. The reason for ignoring these four is not very complicated and can easily be recognized; Venlo is only getting started with c2c, and these problems are not the ones which are likely to appear in the short term, and on the regional scale.

The production problems of biodegradable goods are relevant when the demand becomes enormous, and agricultural capacity becomes too small. However, when only a small region such as Venlo demands biodegradable goods, it will be a realistic target. So, these long-term and large-scale problems accompanying the biodegradable products are not very urgent when implementing c2c on a relatively small scale like Venlo does. What adds to this is that for example in the spatial design plan on Klavertje 4 no attention at all is paid to business or

residential waste reuse. Nothing is said about the reuse of everyday products such as cars or televisions. The problem of biodegradable 'waste' is not relevant for the plans, because the plans do not result in an increase of biodegradable materials. The problem that c2c may not be fully thought through could simply be solved by implementing the concept and learning from it. This is something which is, probably not on purpose and maybe even unaware of this criticism, dealt with by the step-by-step implementation which is taking place. C2c is not suddenly implemented on every aspect; the first steps might result in some lessons which can be used in the next steps. The inevitable growth of the technical cycle was already dismissed in paragraph 2.2.2 as being only temporary. What adds to this is that Braungart, in the same paragraph, explained that c2c is not about everything being perfect; some loss of materials may happen, and therefore a temporary growth of the technical cycle is not that important.

The remaining six criticisms are in one way or another dealt with by Venlo. Most of the problems are countered by the fact that Venlo is not implementing 'pure' c2c; it is mixing it with some other approaches. First of all, the single-minded emphasis of c2c on the technological fix has already been labelled dangerous. Venlo does aim at implementing this 'technical' c2c, but the way the region does it is rather social: business persuasion to become c2c, involving c2c in school education, and continuing to raise environmental awareness. Lukassen (Appendix A) explains that now c2c has made such an advance in the region, this does not mean Venlo is getting rid of all other approaches which have been used previously. "It just doesn't work like that. It could only work when everything would be 100% c2c, and that's not a realistic target on the short term" (Appendix A). This also gives an answer on the second criticism, that c2c does not equal sustainability. The Greenport Venlo spatial design plan offers a clear view on the implementation of c2c within the Venlo region. The criticism was that c2c does not consider climate change, loss of biodiversity and global wealth inequality. However, climate change and loss of biodiversity are prominent features of the Greenport plan; the absence of global wealth inequality is neither surprising nor unreasonable, as most regional spatial plans do not include this aspect. As indicated above, Venlo is not implementing 'pure' c2c; it includes those aspects considered relevant, and may add some other sustainability aspects.

The third of the six remaining criticisms is the lack of quantitative data available on c2c. On the one hand this is not considered a problem, because even though no data is available, local parties continue to believe in c2c. Venlo aims at taking advantage of this, and making as many businesses as possible c2c. On the other hand, the Greenport plan does include some quantitative data, for example on the amount of CO_2 reduction. It can also be argued that the Venlo region will generate its own data over time. While for Venlo the lack of information was not considered problematic, other regions in the future should not be restricted by this either, for they can build on Venlo's experiences.

The fourth criticism dealt with by Venlo is the point that c2c results in a huge increase in transportation and energy demand. This demand would be caused by the continuous collection, disassembly, and reproduction of the materials in the technical cycle. Especially products used individually, such as televisions and cars, require much transportation and energy. However, the Greenport plan only involves the development of a business area, and as indicated earlier, no attention is paid to the reuse of cars or televisions. The only thing the

plan wants to make c2c, is the business park itself: the buildings, the energy provision, and the water system. This means that the plans proposed involve little increase in transportation and energy demand, and therefore no measures have to be taken. Still, the plans for a biomass energy plant do create somewhat extra traffic, in bringing the biomass from all different directions to the facility. Another minor change is the decreasing demand for energy due to the measures taken for buildings to use less electricity. Overall, not much change is expected for both aspects and therefore the need to anticipate on these changes is not present.

The two remaining criticisms regard the role of regulation; when regulation disappears, environmental damage would increase, and c2c would cease to increase profits. On the first of these two a simple answer can be given. As indicated above, Venlo does not suddenly replace all existing regulation by c2c; old regulations will continue to exist for a while, ensuring that current pollution levels will not be exceeded. The second problem of abolishing regulation, the disappearing incentive of c2c, is not considered a problem by any of the actors. Companies in the Venlo region switch to c2c production, the Chamber of Commerce stimulates c2c by workshops and education, and the municipality of Venlo will possibly soon be preparing measures to stimulate c2c as well. This enthusiasm partly emerged without regulation; no financing was available for companies switching to c2c, this all happened voluntarily. However, existing environmental regulation and other government intervention such as taxes on polluting substances did provide an incentive for using c2c. So, the fact that companies are switching to c2c without the Venlo municipality financially stimulating it, partly proves that c2c in itself can be an attractive way of producing. However, it is not possible to say whether the same enthusiasm would have emerged when no environmental regulation at all would have existed.

3.1.4 *The role of the province of Limburg*

Particularly on the aspect of stimulation and regulation of sustainable business activity, the province of Limburg can play an important role. As was mentioned earlier, the province was involved with the Floriade Venlo Principles, which clarifies Limburg's intentions concerning c2c. According to Levels, of the province of Limburg (Appendix C), the province is mainly interested in the improving the process of c2c, rather than being involved in practical application. The goal of Limburg is to use c2c as a catalyst for sustainable development (Provincie Limburg, 2008b). Emerging individual c2c initiatives should embrace c2c of their own accord; Limburg only wants to facilitate and stimulate. C2c activities should evolve autonomously, rather than being based primarily on provincial support. Furthermore, Limburg wants to become and remain the leader in the field of c2c implementation. So, in these aspects Limburg is very similar to the Venlo region.

Levels explains that the province is mainly aiming at development projects using an area development approach ('gebiedsontwikkeling'), on the level of neighbourhoods or small regions. There are no projects of provincial scale which could be stimulated to become c2c, the smaller scale receives primary attention. Also, Limburg aims at connecting various c2c initiatives throughout the province, if beneficial. Next to this, the province wants to create some kind of c2c community, in which c2c knowledge is easily exchangeable. Part of the ambition for facilitating c2c projects is the cooperation with nationwide research institutes. These institutes, such as SenterNovem, provide additional knowledge. This way, c2c

opportunities should be utilized, such as the use of waste heat of certain industries for heating in residential areas. Moreover, to stimulate the c2c process in the province, three million euros are available for the period until 2011.

Sustainability is a very important aspect within Limburg policy, and c2c is chosen as the approach to realize the goals. "C2c offers great economic opportunities, particularly because it stimulates innovation and it approaches sustainable development from an economical perspective" (Provincie Limburg, 2008b). Limburg does choose its own version of c2c, in which eco-effectivity is complemented with the condemned eco-efficiency. Eco-efficiency, which was about 'being less bad', is considered important because the economic use of resources is the first step of sustainable resource use. The province argues that every product which is not needed, does not have to be produced in the first place. For example in the case of energy-use, prevention of energy-use is often cheaper than the sustainable production of extra energy. This contradicts the unlimited consumption advocated by c2c.

The sustainability ambitions are narrowed down to an effort aimed at six points on which Limburg will focus primarily. These six are shown in Box 3.4. Throughout these subgoals, c2c will be the starting point for every intellectual process and will be used as much as possible (Provincie Limburg, 2008b). For every subgoal the specific goals and approaches are worked out more specifically. These practical goals and the corresponding approach are shortly summarized below.

1.	Development and distribution of sustainable development knowledge
2.	Sustainable decision-making
3.	Sustainable operational management of own organisation
4.	Sustainable area-development
5.	Sustainable building and living
6	Sustainable production

Box 3.4   Subgoals of the province of Limburg (Provincie Limburg, 2008b)

Subgoal 1: Development and distribution of sustainable development knowledge
This goal aims at stimulating social learning processes for various parties in society, leading to individual initiatives related to sustainable development. The education system, government institutions, civilians and professionals are all planned to be confronted with the c2c approach. Communication and the creation of networks should distribute the c2c ideology throughout society.

Subgoal 2: Sustainable decision-making
The decisions made by the province should be based on a proper involvement of economical, ecological, and social stakes. Problems should not become the problem of people elsewhere or in the future. To achieve this, sustainability should become embedded within the provincial organisation; every employee should possess adequate knowledge to include all sustainability aspects within decision-making.

Subgoal 3: Sustainable operational management of own organisation
C2c is specifically mentioned as the leading motive in all organisational aspects. Limburg can not be taken seriously as long as the province itself is not implementing some parts of c2c,

and therefore an increasing percentage of all goods bought by the province should be produced in a sustainable manner. The building accommodating the provincial organisation produces no CO_2, and within the building the waste cycle will be closed as much as possible.

Subgoal 4: Sustainable area-development
Spatial development assignments will be designed according to the c2c approach, also including flexibility in both space and time. The added-value of c2c in spatial assignments is that the approach connects the various aspects, such as water and energy. Ten different projects which should exemplify the possibilities of c2c are subsidized by the province. This way, the Limburg province should receive positive international attention as being a c2c-region.

Subgoal 5: Sustainable building and living
This subgoal aims at the design of buildings and infrastructure with respect to their users and also with respect for the environment. From the start of the design phase explicit attention will be paid to the possibilities of using natural materials, energy sources and ecosystems. Buildings should have a relation with the local surroundings to create a pleasurable living or working environment. This way, the economical value of buildings will be strengthened. By 2011 the entire construction sector should realize the benefits offered by sustainable construction and should possess sufficient knowledge to apply sustainability principles in practice. By 2015 all construction projects of the province should be designed and built in a sustainable way, and all existing buildings should be made sustainable as much as possible.

Subgoal 6: Sustainable production
This goal concerns the stimulation of a sustainable way of producing everyday products, in order to boost c2c within Limburg and to stimulate the transition towards a sustainable economy. The principles of c2c offer the major starting point for the rethinking of production processes in order to achieve a sustainable society. Products should be ecologically safe, be disassembled easily, and materials should retain their quality. When production processes become c2c, this stimulates the process of implementing c2c. The leaders in the field of c2c production receive support from the province to stimulate achieving this goal.

Clearly, the province's approach is quite comprehensive; buildings, infrastructure and production processes are stimulated to become c2c. However, not much financing is available, perhaps as a result of the short period of time which has been available to develop policy and set up a financial programme. Right now, Limburg is aiming its efforts at realizing some projects which will serve as examples for the entire region. These projects should both encourage others in the province to do the same, and carry out the image of Limburg as a sustainable c2c region. This offers possibilities for economical growth, as well as the development of ecological and social values.

In conclusion, it becomes clear that both Venlo and Limburg indeed use a "pragmatic" approach, as was indicated by Lukassen (Appendix A). This is confirmed by Lukassen's dismissal of criticisms as being "not very interesting". But it also becomes clear by the way in which is dealt with most of the criticisms. The single-minded technological fix is compensated by maintaining existing regulation and continuous raising of environmental

awareness. The partial nature of c2c is compensated by the integration of relevant aspects within c2c. Both these responses to critique result from the pragmatic approach of the Venlo municipality. The mix of c2c with existing policy seems to be primarily a logical and practical next step rather than a well-considered decision resulting from c2c criticisms. The province of Limburg also argues that a mixture of eco-effectivity and eco-efficiency is necessary.

The fact that no attention is paid by the Venlo region to making everyday products c2c, can be simply explained by the fact that the Greenport plan is about the development of a businesspark. Therefore, there are no intentions of making everyday products, even though these products might also be used on this terrain, entirely c2c. Limburg does try to stimulate c2c production processes for c2c everyday products; however these efforts are limited to set some positive examples. All other responses to c2c critique seem to be representing the pragmatist approach of the Venlo region. In the next paragraph all aspects considered in paragraph 3.1 will be discussed for the case of Almere.

3.2   The Almere Case

3.2.1   Cradle-to-cradle in Almere

Almere is a city of 184.000 inhabitants, located in the middle of the Netherlands, within the Flevoland province (Figure 3.1). The entire area of Flevoland consists of land reclamated from the sea. The first houses of Almere were built in the middle of the 1970's and therefore Almere is a very young city. It is located on the north of the Randstad, the agglomeration in the western part of the Netherlands.

On April 9th 2008, Almere presented the Almere Principles (Box 3.5), which are generally based on c2c, and were created in cooperation with c2c-founder McDonough. These principles concern the city's development until 2030. Almere is planned to increase its population to 350.000 inhabitants in the period 2008-2030, as well as adding 100.000 jobs. The principles are the start of c2c in Almere, providing "a manifesto for an ecological, social and economical sustainable development of Almere 2030" (Gemeente Almere, 2008b, p. 1). The principles should help Almere to become "a vital community with a rich diversity in possibilities for living and working, within a pleasurable abundance of space, water, nature and man-made landscape which will be able to grow and change through time" (Van Oost, 2008, p. 7). All plans which will appear in the forthcoming years will be influenced by the principles; they will acts as a guiding framework for the entire municipality.

For an ecological, social, and economical sustainable future of Almere 2030.
1) Respect diversity
2) Connect place and context
3) Combine city and nature
4) Anticipate change
5) Continue to innovate
6) Design healthy systems
7) People make the city

Box 3.5   The Almere Principles (Gemeente Almere, 2008a)

The Principles are the product of agreements between Almere and the national government made in October 2007. These agreements result from the UPR (Urgentieprogramma Randstad, or Urgency Programme Randstad), in which the national government made a total of thirty-three agreements with various parties in the Randstad. One of these thirty-three is the deal made with Almere. Almere is considered an important part of the Noordvleugel, the northernmost part of the Randstad. The deal includes some quantitative agreements, for example the growth to 350.000 inhabitants, as well as some qualitative aspects, such as the role of sustainable development as guiding principle. Almere proposed using c2c as the sustainability approach, and this way the Almere Principles emerged.
Next to the national and the municipal governments, also the province, the local waterboard, and the GOB (Gemeenschappelijk Ontwikkelingsbedrijf, or Collective Development Organisation) are involved. The province does not particularly adopt c2c, in the way the province of Limburg did. Therefore, in this casestudy no further attention will be paid to specific provincial efforts.

According to Van Oost, senior advisor Environment & Urban Development at the municipality of Almere (Appendix D), the Principles are particularly based on the Hannover Principles. These Principles were formulated in 1992 by c2c founders McDonough and Braungart for the Expo 2000 in Hannover, Germany (Appendix E). Even though the Hannover Principles can be considered somewhat more comprehensive than c2c, many c2c aspects can be recognized in them. C2c is seen as a part of these Principles, not representing the entire sustainability picture. C2c picked some aspects of the Principles and worked them out in detail. Yet, Almere chose the Hannover Principles to base their own Principles on. So, Almere, similar to Venlo, is not implementing 'pure' c2c, rather their approach was inspired by the Hannover Principles, which is not exactly the same. One could even question whether the term c2c can be applied on Almere's efforts, as it resembles the Hannover Principles rather than c2c. However, Almere names their efforts 'c2c', and therefore in this research the same will be done. The question whether c2c is essentially the same will be discussed later in this research.

The main reason for choosing c2c instead of another approach for Almere is the optimistic and integrated nature of c2c. A change is needed away from the conservative and defensive reasoning which dominated the sustainability and environmental debate. Sustainability was expensive, unattractive and limiting development. This way, the economy versus ecology opposition could never be resolved. Furthermore, the limitations of what can be accomplished without integrating various sectors were reached. As long as all sectors are handled separately, no further progress could be made. C2c offers an integrated approach, which can link all sectoral aspects, and this way could create new opportunities. Van Oost (Appendix D) indicates this means a dramatic change in paradigm, which could easily take twenty years to succeed. Yet, this transformation is needed in order to take the next step.

The Almere Principles are approved by the most important municipal political institutions: the local council and the major and aldermen. This means that c2c is official policy and will be translated into all other plans. Future plans will incorporate c2c, and existing plans will be tested whether their content fits the new c2c approach. Almere aims at making the whole city

sustainable, and to achieve that one year remains to formulate an integrated framework of agreements.

Van Oost argues that Almere is specifically suited for c2c, because the city has always been concerned with sustainability. In the years the city was designed, environmental awareness started to emerge and the city design was affected by it. This resulted in the presence of multiple town centres, investments in green and water structures, and an emphasis on public transport. Also, the city's population is young, and accustomed to change.
What adds to this is the fact that the enormous planned growth of the city offers additional opportunities to include c2c from the start. Almere recognizes this opportunity and aims at utilizing this expansion as a catalyst for change. The role of the Almere Principles is to offer a guiding and inspirational perspective.

3.2.2   Practical implementation

The main areas where Almere plans to expand are on the eastern (Eastern Almere) and the western (Almere Poort and Almere Pampus) side of the city. For Eastern Almere some steps are formulated according to which the strategic goals are translated towards practical implementation. For the western parts a Masterplan is under development, but this is not yet finished. The fact that not much plans are finished yet can simply be explained by the fact that the Principles have been adopted only very recently, in April 2008. Therefore, some time will have to pass before more is known on practical matters. Nevertheless, this paragraph will try to discuss as many practical parts of Almere's plans as possible to answer the questions which were posed at the beginning of this chapter. These questions included the level of scale, the regional processes to which c2c is applied, and the intervention strategies used to achieve implementation.

Van Oost (Appendix D) provides some information on the aspects related to these questions. First of all, the level of scale ranges from the micro-scale to the regional scale. The large scale of the city expansion to 350.000 inhabitants causes some high-level aspects to be included, such as regional infrastructure. However, Almere does not know yet whether and how c2c will be applied on this regional infrastructure. In any case, regional public transport will be upgraded, which is generally c2c because of the bundling of flows of traffic; one vehicle replaces several others, which increases the effectivity of transport. Almere aims at applying c2c on all aspects and all levels. This is because the management of cycles is considered important at all levels. The micro-scale concerns buildings; buildings can save or even produce energy. The importance of buildings was already seen in the Venlo case, where buildings had various functions, such as water storage and flora and fauna habitat, due to the green roofs. Other scales, such as neighbourhood or city, are relevant for other cycles. The regional level is represented by the role of Almere in the Noordvleugel. For all these levels, the municipality is examining what opportunities are offered by c2c. The approach is not simply applied on everything; the most feasible applications are currently researched. Therefore, at this moment, not much can be concluded on this.

With regard to the implementation on regional processes; Almere does not include all processes. For example making everyday products, such as cars and televisions, c2c is not

something which the municipality includes in its efforts. This is similar to Venlo, where this aspect did not receive attention either. An aspect which prominently is related to c2c in Almere, is energy. Within future neighbourhoods energy is a primary aspect; the buildings should be saving or even producing energy. One of the options for Eastern Almere is produce so much energy that the whole city can depend on it. This production should at least partly be realized by individual houses and buildings, rather than building one enormous central energy plant. Decentralized, small-scale energy provision is one of the strategies used to create a sustainable energy provision. Also, the cascading approach (discussed in chapter 2) is planned to play a role within this process, resulting in cascades to use energy as efficiently as possible. In the western part of Almere a small island designated entirely for solar energy production will be realized. This project is partly subsidized by the European Union. Furthermore, Almere utilizes waste heat from the local electricity plant for warming residential buildings. Also, a power plant located in Diemen, some twenty kilometres away from Almere, will be used for the same purpose. Both plants still use fossil fuels, but Almere is aiming at transforming the plants to use biomass.

On other aspects, the municipality is not that clear. According to Van Oost (Appendix D), wastewater is planned to be utilized; warmth and nutrients from the water should be made useful. The waterboard is one of the parties which are involved in this process. The place for nature within the city, one of the points in the Almere Principles, is also important. The aim of Eastern Almere is to create an urban area with a biodiversity greater than in the surroundings. Within Eastern Almere, the infrastructure will be oriented towards public transport and bicycle facilities, while car-use will be limited to a minimum (Gemeente Almere, 2008c).

However, these previously mentioned aspects are not yet completely laid down in official plans. No assurance can be offered on to what extent all good intentions will eventually be realized. Most developments are very recent and new, and are therefore still subject to discussion and change. Important to note is that not all forementioned developments are recent; the energy-related interventions existed before c2c emerged. The policy of Almere was already aiming at sustainable energy provision, and therefore the developments are not directly related to the c2c goals. The adoption of c2c and the Almere Principles could represent the next step, according to Van Oost.

The third aspect to discuss is the way Almere is trying to implement c2c and the Principles. Van Oost indicates that a restrictive strategy is not what they consider appropriate. The reason for adopting c2c was its optimistic and positive nature, and therefore a similar approach seems to be suitable. This is similar to Venlo's strategy, although there are some differences. Almere aims at attracting c2c companies as well, but is not working together with the local Chamber of Commerce like Venlo does. Potential c2c business activity is stimulated by the planned establishment of a Business and Science Center for sustainable business activity. This should offer an incentive for developing parties, it should retain the c2c knowledge within the region, and create a network for c2c companies. Also, some practical measures could be taken in the future to stimulate sustainable companies to settle in Almere; such as lowering ground prices for every sustainable measure taken by companies.

Regarding the aim of creating energy-producing buildings a conflict arises. One of the Principles states 'People make the city', and an example of this is a project which enables people to partly design their own residence in the new neighbourhoods. Even though his

project was already started before the arrival of the Principles, it does fit within this particular Principle. This project conflicts with the aim of creating energy producing houses, buildings and neighbourhoods. Most people do not voluntarily include all kinds of short-term expensive measures in their house, and therefore the municipality has to stimulate this. It is not legally allowed to oblige people to apply energy-related measures, so Almere has to rely on educational measures, with no certainty regarding results.

In short, Almere uses no restrictive intervention strategies, but it does plan to use some stimulation and educational measures. This is very similar to the approach used by Venlo. In the next section Almere will be reviewed on its responses to c2c criticisms, in order to get a more in-depth picture of the Almere c2c efforts. The same was done in paragraph 3.1.3 for Venlo.

3.2.3 *Almere's response to cradle-to-cradle criticisms*

When looking at Box 3.3 in paragraph 3.1.3, where Venlo's responses to c2c critique were summarized, it seems that in fact the response of Almere is shown. Both regions are very similar in the way they implement c2c; therefore, Box 3.3 can be used to represent Almere as well. Both regions do not consider c2c as the only solution possible, and combine the approach with some other strategies. For all ten criticisms, the regions' reply is generally the same. Almere's solutions are shortly summarized in this paragraph.

The technological fix problem is avoided by Almere by adding some things which were not specifically stated in the 2002 c2c book. The inspiration for Almere with regard to their principles were the Hannover Principles rather than the c2c book, and therefore there are some differences with c2c. Almere's approach can be seen as more comprehensive than c2c, because both c2c and some other strategies are included. This way, the problem of c2c not equalling sustainability is solved as well. The point that c2c is not fully thought through is mainly ignored, just as the supposedly inevitable growth of the technical cycle. The lack of quantitative research on c2c is compensated by some research on the proposed solutions, similar to Venlo. The problematic consequences of biological nutrients are ignored, partly because those problems are less urgent on the scale of a city, and partly because the contents of everyday products are not part of the plans. The increase of transport and energy is not significant because this would have resulted from c2c everyday products. The measures concerning transport and energy are about making them sustainable rather than about facilitating an increasing demand. The problems arising with the mass production of biodegradable materials are not relevant for Almere, just as for Venlo, and are therefore not integrated in the plans. Finally, the role of regulation is the same as in Venlo; existing regulation is maintained, while c2c is stimulated by non-restrictive means.

3.3   Conclusion

All by all, the cases of Venlo and Almere seem to be quite similar. Both regions are rather ambitious with regard to the role of c2c as booster for development. Both include a range of parties in their efforts, ranging from the national government to local businesses. Venlo also includes adjacent municipalities and the Chamber of Commerce, which in Almere do not play a significant role. Other differences include the main application of c2c; Venlo is primarily

implementing c2c on business areas, while Almere is planning to apply it on the entire city, including residential areas. This will have different implications on practical implementation; however these consequences are not yet visible, due to the fact that the c2c approach has only recently emerged. So, the most interesting consequences of the differences between both regions have yet to become visible. Furthermore, the situation of both regions is different and therefore the motives for using c2c could differ. Venlo is a region which will, in the coming years, experience a decline in population, and therefore tries to differentiate the region from other regions. C2c is the way to state that Venlo and surroundings are attractive and innovative, and this way the municipality tries to put a halt to the possible decrease in population and economy. Almere, however, is a city which grows exceptionally fast; the reason for this is the beneficial location of the city, next to the Randstad. Almere, contrary to the Randstad, still has space available to expand, because the city is so young. Therefore, Almere offers special opportunities; there is both plenty of space and demand for that space. So, for Almere c2c is more a new and integrated approach which is used to create a sustainable city, rather than a marketing tool. However, in Almere as well as in Venlo, the positivism of c2c was an important reason for choosing c2c.

Both regions confirm one of the conclusions of chapter 2, which stated that the main accomplishment of c2c is that it created a bridge between economy and ecology, which inspires people and creates enthusiasm. Venlo simply uses this optimism to persuade companies to become c2c and brand the region as sustainable and innovative. Almere also aims at attracting and creating c2c businesses, but it also adopts c2c to cause a change in paradigm. This change should result in more comprehensive, integrated and development-oriented planning, rather than sector-oriented, restrictive planning which continues to set economy and ecology against each other.

The main questions posed in chapter 1 relevant for this chapter were about the way how c2c has been put into practice elsewhere in the Netherlands, and what could be learnt from these attempts, with regard to implementation, the level of scale used, and the processes to which it is applied. All these aspects were discussed in this chapter, except the lessons which can be learnt from them. This will be done in chapter 5, where the possibilities of c2c for spatial planning in the province of Groningen are examined on the basis of the first four chapters. In the next chapter the policy of the province of Groningen will be discussed, in order to review the policy on measures similar to c2c.

Chapter 4: Policy of the province of Groningen

The previous chapter discussed how the regions of Venlo and Almere are implementing c2c. The province of Groningen has not adopted the approach within general planning policy, yet it could be that Groningen does apply some principles which also are part of c2c. Maybe Groningen already uses several concepts of c2c without referring to it as c2c. It does not make sense to examine c2c possibilities for Groningen when the province already uses it. Furthermore, the current policy could take some steps towards c2c, without taking the next step towards the approach itself. Perhaps the policy leaves some aspects open, or discusses some problems on which c2c could be the answer. In this chapter these questions will be examined, in order to find opportunities for c2c in Groningen. The main document that is analyzed is the draft Provincial Environmental Plan or 'Provinciaal Omgevingsplan' (POP), which is likely to be finalized by the end of this year. This plan is the main spatial plan and is the starting point for all other spatial plans.

4.1   The Provincial Environmental Plan

The POP is the main spatial plan of the province of Groningen, which represents the regional level. It contains the provincial policy concerning the physical environment. It has a strategic nature and concerns planning ('inrichting'), quality and management of the physical environment. The POP acts as a guideline for the province itself, and serves as a framework for municipalities and waterboards. The current POP will lose its validity in 2010, and some new developments urge the province to make a new plan. This new POP will first apply for the period 2009-2013, and can be extended to remain valid for another two years (Provincie Groningen, 2008a). For this research, the POP is the most relevant plan to examine, because it contains the strategic goals and policy for all planning-related aspects in Groningen. The goal is to examine whether the province is trying to implement concepts or goals similar to c2c. This is important because the opportunities for Groningen can not be seen independently from the existing policy. If Groningen would adopt c2c, the existing policy could form important restraints or opportunities to the success of c2c in Groningen.

Within the new POP, sector-oriented plans concerning spatial planning, the environment, mobility and water are integrated. Other aspects such as economy, culture and well-being are also part of the plan, as far as they have spatial implications. The plan consists of four main parts: vision, policy, area-specific development assignments, and specific regulations. The third part concerns specific policy on certain areas considered important by the province. The contents of this part are not relevant to this research because it does not aid in answering the questions posed at the beginning of this chapter. The three other parts combined - vision, policy, and regulation - will provide some answers on the question whether c2c is already to some extent part of Groningen policy. In the first place, the vision of Groningen expressed in the POP will be reviewed; only those goals and ambitions which are similar to the goals and ambitions of c2c will be selected. Secondly, the policy part of the plan will be examined in order to find out what efforts are made at realizing these goals and ambitions. Finally, the regulations will be studied to list all existing measures related to reaching the goals. The

purpose of this is to find out to what extent the goals, policy, and regulations are similar to c2c. The next three paragraphs will discuss each three of the relevant POP sections.

4.2 Vision of the POP

The first major part of the POP, as mentioned earlier, is the vision on the future of the province of Groningen. In this part is expressed which aspects are considered important and which goals the province aims at, while the policy part will clarify how it should be reached. Of relevance for this research are only those goals and ambitions which are similar to those of c2c; therefore, the goals not similar to c2c will not be discussed.

The main goal of the plan is *"sustainable development – sufficient employment and a liveable Groningen for both man and nature, with preservation and strengthening of the qualities of the physical environment, in which future generations are offered enough possibilities to unfold/develop/open out themselves"* (Provincie Groningen, 2008a, p. 7). This main goal of sustainable development is split up into six different general themes. These themes and the corresponding general goals are shown in Box 4.1.

Theme	General goal
Clean and safe Groningen	Clean, healthy and safe environment of living
Characteristic Groningen	Characteristic living environment and high-quality nature
Accessible Groningen	Good accessibility
Enterprising Groningen	Strong regional economy
Energetic Groningen	Sustainable energy provision/facilities
Working and living in Groningen	High quality of living for all inhabitants

Box 4.1   General goals of the POP by theme

These general goals can be considered somewhat obvious; all regions would like to have the qualities mentioned in Box 4.1. It is more interesting to look at some more specific goals mentioned in this part of the new POP. They provide more clarity on what exactly should be accomplished, and therefore are more relevant to judge on their similarity with c2c. Therefore, the general goals mentioned in Box 4.1 are not discussed any further. They generally serve as an indication what the general goals of Groningen aim at. These goals could all apply to c2c. However, when considering the more specific goals expressed in the plan, it becomes clear that some goals are not at all similar to c2c. For the remainder of this paragraph, some of these specific goals similar to c2c are chosen and later on will also be judged on whether and how they are implemented by further policy and regulations.

The specific goals expressed in the visionary part of the POP which will be examined further are shown in Box 4.2. These are the goals mentioned in the plan which are the most similar to c2c goals and philosophy. Most other goals either have not a clear link with c2c, such as the adaptation to climate change, or are not very similar or even in contrast to c2c, such as the aim of creating possibilities for the extraction of raw materials. Therefore, those goals are not considered. From all goals expressed in this visionary part of the new POP, these four goals represent some 39% (Appendix F). This means that the other 61% does not have anything to

do with c2c. This already indicates that the province does not comprehensively use the c2c approach within policy.

> *"We will aim at an economic use of resources and energy, and at the creation of chains ('ketenvorming') and/or bundling with other production processes" (Provincie Groningen, 2008a, p. 7).*
>
> *"A clean, healthy and safe living environment" (Provincie Groningen, 2008a, p. 12).*
>
> *The strength of a living environment often can be found in diversity. We want to strengthen that diversity. We aim at carrying out the picture of a province with diverse natural and landscape qualities (…) and stimulate corresponding developments (Provincie Groningen, 2008a, p. 13)*
>
> *"We aim at positioning our province both nationally and internationally as a leader on the area of energy, and provide a large contribution to European and national energy- and climate goals. (…) The goal is a sustainable energy provision within fifty years" (Provincie Groningen, 2008a, p. 15).*

Box 4.2   Specific goals of the POP which will be examined in this chapter

The first of the goals mentioned is particularly comparable with c2c, due to the call for creation of chains, or cascades, and bundling of various production processes. This is one of the main points of c2c; bringing production processes and flows of materials together in an effort to use resources as economical as possible, and close material cycles.

The second goal, aiming at a clean and healthy environment, is also similar to the c2c philosophy. The link between this goal and c2c is very clear, as c2c also aims at an environment which is clean, healthy and safe; it is even one of the main ideas behind c2c. C2c's way of realizing this healthy environment would be to eliminate all sources of pollution in a technical manner. Hazardous chemicals would not be used, emissions of particulate matter eliminated, and no dangerous wastes would be created any longer. The question is whether c2c and the new POP are making the same efforts in realizing this goal.

The third goal, which aims at diversity, both in nature and in landscape, resembles c2c in 'respecting diversity', and even enhancing it. Although the strengthening of diversity in landscape is not a prime objective of c2c, it is something which certainly is part of c2c. C2c aims at utilizing diversity in order to optimize solutions, rather than creating diversity for aesthetic purposes. However, natural diversity and biodiversity are also aspects which are considered important within c2c. Also, a diverse environment is within c2c also considered as an attractive environment.

Finally, the goal calling for energy and climate sustainability only is somewhat comparable to c2c, because the emphasis of c2c is not primarily on sustainable energy use. However, as previously indicated in paragraph 2.2.2, c2c does argue in favour of sustainable energy use and climate-friendly solutions. Chapter 2 already showed how c2c can deal with this goal; using Trias Energetica and the cascading approach. According to these solutions, prevention of energy use is the first objective, while the remaining demand should be filled in by renewable energy sources, and all energy sources should be used as efficiently as possible. Whether the POP will use the same c2c strategies will be reviewed in the next paragraph.

In summary, when reviewing the new POP merely on the general goals shown in Box 4.1, it seems that it greatly resembles c2c. All of these goals are very similar to c2c goals. When looking a little closer, the goals stated in Box 4.2 can be identified as the ones most similar to c2c (Appendix F). Already 61% of the goals are left out, as they do not represent c2c ideology. This means the POP certainly does not involve a clear adoption of c2c. Nevertheless it is important to review the remaining 39% of the goals in order to identify possible opportunities for c2c. Some of these goals are not suitable for reviewing, as they are too general (Appendix F). All remaining goals are represented by the four specific ones mentioned in Box 4.2. It is still wise to keep in mind that these goals are still quite general and that it is too early to conclude that the new POP is for this part comparable to c2c. To further examine the question whether the province uses principles also part of c2c, now will be looked at the policy part of the plan. The question is, as it is for all four goals, whether this goal is also found in the policy part of the POP, and how it is made more specific.

4.3   Policy of the POP

The previous paragraph made clear what the province wants to achieve, but not how the province is going to achieve it exactly. This is explained in the policy part of the new POP, and this part will be reviewed in this paragraph. The specific strategies to achieve the four goals from Box 4.2 are most relevant to this research, because these strategies could resemble c2c. First will be checked whether the goals mentioned actually return in the policy part, and second the measures related to achieving the goals will be reviewed. It could be that Groningen states all kinds of wonderful goals in the visionary part, but they are not mentioned elsewhere in the plan. That way no practical implementation strategies are defined and it can not be expected that the goal actually will be realized. Every POP paragraph explains what should be realized, and at the end of every paragraph the practical measures related to realizing each separate goal are summed up in a table. This table is very important, because it contains the specific and concrete goals, and also the way they should be realized, for example using regulation or funding. Again, the goal is to find out whether the POP includes c2c strategies.

The first goal was:
"We will aim at an economic use of resources and energy, and at the creation of chains ('ketenvorming') and/or bundling with other production processes" (Provincie Groningen, 2008a, p. 7).

The first occasion when cascading is mentioned is in the part on 'enterprising Groningen', where concentration of business activities in designated zones is advocated. This presumably offers possibilities for *"waste reuse, collective use of waste heat, and creation of chains (cascading) of business activities"* (Provincie Groningen, 2008a, p. 93).
The second reference to cascading is made in the chapter on 'Energetic Groningen', where explicitly is stated that the province chooses cascading within energy use.

It is now relevant to look at the corresponding table to check whether these goals are accompanied by adequate measures. In the first case however, the table only indicates measures aimed at concentrating business activities, and no single reference is made towards stimulating cascading or collective waste reuse. The will to strive for cascading is expressed, but the POP does not take any measures to implement the approach.

The second reference to cascading concerned sustainable energy use. The table of measures not clearly refers to cascading, but the goal of 'starting up of new developments within energy-infrastructure' could refer to it. Although this reference does not explicitly mention cascading or other c2c approaches, it is likely that cascading is meant as one of the 'new developments' within energy. Especially because references to cascading were already made earlier in the plan.

Within this first goal, not only cascading is advocated, also economic use of resources and bundling of production processes is proposed. This returns only once in the policy part, but remarkably the table of measures makes no further reference to it.

Furthermore, a national law requires the province to request companies to pay attention to saving energy, reuse and prevention of waste, and using fewer raw materials. This is also mentioned in the table of measures.

Overall, the goal comes to the front on several occasions, however not every time there are clear measures attached to it. Box 4.3 provides a survey of the measures in relation to the first main goal and the several sub-goals described.

Main goal 1	Specific c2c policy goals	Measures within policy
"We will aim at an economic use of resources and energy, and at the creation of chains ('ketenvorming') and/or bundling with other production processes."	Making use of cascading opportunities which result from concentration of business activity.	-
	Using cascading within energy use.	Starting up of new developments within energy-infrastructure.
	Economic use of resources and bundling of production processes.	-
	Saving energy and resources.	Requesting companies to pay attention to saving energy, reuse and prevention of waste, and using less raw materials.

Box 4.3   Measures related to main goal 1

In conclusion, the only concrete measure taken by the province is the starting up of new developments within energy infrastructure. One of the new developments could be cascading, yet this is not made entirely clear. This measure is accompanied with subsidies and co-financing solutions. The other measure mentioned is one which is obligatory due to national regulation, and therefore should not be considered a provincial measure.

Clearly, the POP is very cautious in being more specific on this main goal. Some guiding references are made to cascading and bundling of production processes, but the corresponding measures are often missing. Especially on the bundling of production processes no single measure is taken, while on cascading some modest measures are proposed. It could be that the province lacks the knowledge of how such new approaches should be implemented. Or Groningen is not sure yet whether it wants to fully stimulate these new and uncertain approaches. Whatever the case, it has become clear that the goal expressed in the visionary part is not fully backed up by the policy part.

The second goal was:
"A clean, healthy and safe living environment" (Provincie Groningen, 2008a, p. 12).

In the POP the chapter dealing with this goal is divided into nine separate goals. Six of these nine goals are primarily aimed at supervision, inspection and permissions. These goals include dealing with hazardous materials, limiting health dangers in the direct environment such as particulate matter or air pollution, and limiting negative effects in case of disasters. The solutions offered for these problems are all aimed at dealing with their consequences rather than preventing them. So, they are not relevant. One of the three remaining goals is not really relevant for c2c comparison, which is adequate protection against flooding. This aspect of regional planning does not have anything to do with c2c, as c2c does not state anything on this aspect. If Groningen does adopt c2c, it would still require policy on flood protection. The two remaining goals do have some c2c contents. First, within the aim of good soil quality, attention is paid towards reduction of ground use and also to the reuse of ground in construction activities. This has little to do with a clean, healthy and safe living environment, but it does have a link with c2c. And second, within the waste management section, prevention of waste is specifically advocated. Moreover, the province indicates it supports innovative developments for reducing and reusing waste, and for this purpose some funds is made available. In Box 4.4 all relevant goals and measures can be found.

Main goal 2	Specific c2c policy goals	Measures within policy
"A clean, healthy and safe living environment."	Reduction of use and reuse of ground in construction.	Regulating flows of ground.
	Waste prevention and reuse.	Stimulating waste prevention and reuse by financing

Box 4.4   Measures related to main goal 2

All by all, by far most solutions working towards the main goal of a clean, healthy and safe environment do not have anything to do with c2c. Two of them potentially resemble c2c, yet the degree to which they in practice are similar to c2c does not become completely clear. For example, the aim at preventing and reusing waste seems very comparable to c2c. However the possibility of industries constantly reusing their own materials or the idea of creating biodegradable materials was not mentioned. Also, the aim of reducing the use of ground for construction activities is a minor aspect, which is far less important than other aspects discussed in this chapter. This means that making this aspect c2c does not make a great contribution. When the province would like to implement c2c strategies, it would probably

not begin with this aspect. It is of minor importance, and the possible results are not very visible and therefore not very inspiring.

So, within the chapter on the clean, healthy and safe living environment a small part of the contents can be linked with c2c. The province does mention some aspects very shortly, but by far most solutions chosen, such as supervision, and the granting of permissions, are in fact the opposite of c2c. As was explained in chapter 2, c2c aims at individual initiatives rather than government regulations to achieve sustainability. Regulations are argued a restriction to initiatives and creativity.

In contrast, one could also argue that c2c's aim of creating healthy emissions and producing biodegradable goods is not entirely related to spatial planning. It is not the task of spatial planning to regulate the types of chemicals used by industry. Therefore, it is partly not surprising to find so few references to c2c within this part of the policy document.

The third goal was:
The strength of a living environment often can be found in diversity. We want to strengthen that diversity. We aim at carrying out the picture of a province with diverse natural and landscape qualities (…) and stimulate corresponding developments (Provincie Groningen, 2008a, p. 13)

In the new POP diversity of landscape is considered important because of its attractiveness as a living and working environment. Various protective measures are proposed; conservation and strengthening of characteristic qualities, and protection of cultural, ecological and archaeological values. But not everything is regulative in nature; development which does not disturb values of landscape is advocated in the plan.

Moreover, the protection of various endangered species is made important. This is partly required by national regulation, such as the realization of the national ecological structure ('ecologische hoofdstructuur', EHS). This is a nationwide realization of nature conservation areas, aimed at connecting various areas by corridors. C2c is also concerned with providing flora and fauna habitat within development.

The new POP is filled with measures to protect the landscape and natural values. Many measures can be found; seven different measures for landscape protection and no less than fifteen for protection and development of nature. A short summary of these measures is shown in Box 4.5.

Main goal 3	Specific c2c policy goals	Measures within policy
"The strength of a living environment often can be found in diversity. We want to strengthen that diversity. We aim at carrying out the picture of a province with diverse natural and landscape qualities (…) and stimulate corresponding developments."	High quality of landscape, by stimulating diversity.	Protection and strengthening of key landscape characteristics, by regulations, advice and funding
	High quality of nature.	Protection of endangered species, providing of habitat and stimulating promising developments, by means of financing and regulations.

Box 4.5   *Measures related to main goal 3*

In general, these goals are corresponding to c2c goals. Both aim at creating possibilities for nature to flourish, and both also aim at stimulating development which is 'good'. In this case that means development that does not harm specific natural or landscape qualities. However, most measures do not stimulate 'good' development, instead they are very conservative. Particularly the measures attached to the nature goals are almost all oriented towards restrictions. Financing is available to protect certain species, and regulations are used to limit developments which are considered bad. One could argue that this is in contrast with c2c, because c2c wants to limit restrictions on development. A c2c solution would have been to allow development within nature, as long as nature's values are incorporated in the development.

Overall, this main goal is very similar to c2c, and the way the main goal should be realized is also somewhat c2c, in the aim of stimulating 'good' development. However, it is important to note that the strengthening of landscape and natural diversity is not the main objective of c2c. It is mostly something which is an indirect result of c2c, because the main goal of c2c is to eliminate waste and pollution. Also, c2c is primarily about creating nature within development, create buildings which offer habitat to flora and fauna, and enabling natural life in human environments; basically allowing development everywhere, as long as nature is given its place within space. This aspect is only marginally mentioned in the new POP, as nearly all natural measures are about protection and conservation, and no measure advocates this c2c solution.
Therefore, despite the detailed goals and abundant measures, this third goal can not be termed c2c.

The fourth goal was:
"We aim at positioning our province both nationally and internationally as a leader on the area of energy, and provide a large contribution to European and national energy- and climate goals. (…) The goal is a sustainable energy provision within fifty years" (Provincie Groningen, 2008a, p. 15).

The use of cascading in realizing the stated energy goals was already discussed earlier in this paragraph, and will not be reviewed again. The chapter of the plan which deals with 'energetic Groningen' is full of goals and strategies making an effort to realize this fourth main goal. For example, the province is willing to finance research and innovation, is creating regulation which stimulates wind and solar power, and proposes stimulation of small-scale energy production by agriculture. However not all of these measures are similar to c2c, as is shown by the production of energy from manure and biomass. The POP proposes stimulation of low-scale energy production such as the utilization of manure and biomass at farms. This can be considered c2c because output from one process becomes input in another process. However, during this transformation the quality of the 'food' is lost; once the materials are transformed into energy, it cannot be used again. This linear process, which requires constant new input to maintain it, can therefore hardly be termed c2c. Box 4.6 shows the relevant goals and regulations for this fourth goal.

Main goal 4	Specific c2c policy goals	Measures within policy
"We aim at positioning our province both nationally and internationally as a leader on the area of energy, and provide a large contribution to European and national energy- and climate goals. (…) The goal is a sustainable energy provision within fifty years."	Stimulate sustainable energy and reducing CO_2 emissions.	Stimulating sustainable energy by subsidies and co-financing. Research reuse of CO_2 in industry and horticulture. Saving energy within own provincial organisation.

Box 4.6   Measures related to main goal 4

In conclusion, it is clear that the new POP contains plenty of goals but also measures to realize the fourth goal; the province really seems to be making an effort here.
However, even though the province makes this specific effort, this does not mean that the POP involves c2c. Some solutions proposed by the plan greatly resemble c2c, such as the forementioned small-scale agricultural energy production. Others, however, are opposing c2c, such as the financial stimulation of CO_2 storage. This is an example of a cradle-to-grave solution, as the CO_2 is being put away instead of being utilized.
Furthermore, just as with the previous goal, sustainable energy use is not the main point of c2c. The only similarity of the provincial policy and c2c is that both aim at creating a sustainable energy provision. However, there are no clues that the provincial policy in this part has any further relation with c2c. Perhaps the regulations of the new POP show a clear resemblance with c2c.

4.4   Regulation of the POP

The final part of the new POP which will be discusses in this chapter is the part on regulations, POV. ('Provinciale Omgevingsverordening'). This is a separate document, but it is an official part of the complete POP. It contains all kinds of very specific policy, which is legally binding for all parties; governments as well as businesses and individuals. For

example, the POV states that it is not allowed for local land-use plans, made by municipalities, to change the route of certain waterways or roads. The question whether this kind of very strict regulation fits the c2c ideology is not really relevant at the moment, because the purpose of this chapter was to compare Groningen policy with c2c. The four goals mentioned in Box 4.2, and discussed in the previous paragraph, will again be the reference in reviewing the regulation part. In Box 4.7 all POV regulations which are similar to c2c philosophy as well as relate to one of the four goals are summarized.

It is not surprising that the POV includes many restrictions, permissions and prohibitions, as that is the main function of this part of the POP. The POV consists of several parts, of which the general part and the part on enforcement do not include relevant regulations. The three remaining parts concern the environment, water and spatial planning.
First of all, the environmental part merely includes regulative measures aimed at protection and conservation. For example, it involves regulations on the discharge of wastewater. No stimulative measures are mentioned, and no single relation with c2c can be recognized.
The second part, on water does include many regulative norms and standards. For example that a flood risk of once in every 100 years is acceptable. One aspect which offers possibilities for c2c implementation, the withdrawal of water from surface water, is also included. In this case, parties withdrawing water could be stimulated or obliged to return all water to the same lake or stream from which it was withdrawn. This way, the water cycle would be closed, and the particular party would use the water in a c2c manner. However, the only measures taken in the POV are commitments for those parties to inform the province on the amount of water which was withdrawn. Also, a permit is needed in order to withdraw water. Nothing is said about water returning into the water cycle. In the rest of the part on water no further references are made to c2c, just as in the environmental part.
Finally, the part on spatial planning mostly concerns obligations for municipalities. For example, these include the maximum allowed height of advertisement boards, the number of houses every municipality is allowed to build, and the types of buildings allowed in certain protected areas. However, next to these restriction, also some commitments are mentioned which are quite similar to c2c. Within the section on spatial quality, the following is included:

"The explanations accompanying the local land-use plan should offer insights in aspects of sustainability and the environment. Sustainability in this context concerns social and economical aspects, and environmental aspects. (…) The explanations accompanying the local land-use plan also offer insights into the way and the extent to which the plan is based on guiding energy-principles, among which at least cascading, waste heat utilization, coupling of functions, and energy-efficiency (Provincie Groningen, 2008b, p. 18)

This reference to these energy approaches similar to c2c is very explicit. The POV obliges all municipalities in the Groningen province to include the forementioned concepts in their local land-use plans. This is an example of the way the province could try to get c2c started in Groningen. The same could have been done for many other aspects, such as waste prevention and reuse. However, this reference to c2c remains the only one in the entire POV. In Box 4.7 this obligation related to c2c is combined with the four goals which are examined in this chapter. In short, it makes clear that the POV is not very concerned with c2c ideology.

Specific goal (from Box 4.2)	Related c2c POV regulations
"We will aim at an economic use of raw materials/resources (grondstoffen) and energy, and at the creation of chains (ketenvorming) and/or collection (bundeling) with other production processes."	Oblige municipalities to include a review in their local land-use plan which explains how and to what extent cascading, waste heat-utilization, coupling of functions and energy-efficiency played a role in the plan.
"A clean, healthy and safe living environment."	-
The strength of a living environment often can be found in diversity. We want to strengthen that diversity. We aim at carrying out the picture of a province with diverse natural and landscape qualities (…) and stimulate corresponding developments."	-
"We aim at positioning our province both nationally and internationally as a leader on the area of energy, and provide a large contribution to European and national energy- and climate goals. (…) The goal is a sustainable energy provision within fifty years."	-

Box 4.7   Specific c2c measures from the POV document

4.5   The POP and cradle-to-cradle

In conclusion, it is clear that the POV does not take a special interest in c2c. The document has a very restrictive nature, and virtually all relevant aspects are approached from a regulative and conservative point of view. Yet, this is the main purpose of the regulations part, the POV; ensuring a certain basis quality. In chapter 2 was argued that c2c favours the abolishment of regulations, because they form a restriction on individual initiatives and creativity. From paragraph 4.4 becomes clear that government regulation indeed can play a restrictive and limiting role. The nature of the POV is opposite to the ideology of c2c. This conclusion generally applies on the entire POP, as very few references are made to c2c. First of all, by far the greatest part of all goals did not resemble c2c; 61% did not resemble c2c philosophy. In paragraph 4.3 turned out that even the goals which did appear similar to c2c were not accompanied by corresponding measures. Paragraph 4.4 completed this picture of the POP not resembling c2c. The fact that the words cradle-to-cradle did not appear in the plan does not mean that the plan does not involve measures similar to c2c. However, the fact that the province apparently prefers very different approaches, does lead to the conclusion that Groningen is not using c2c at all.

Furthermore, something quite different is striking about the new POP. When examining the document, it becomes clear that almost all approaches used are sector-based, and no integration between the various sectors seems to exist. The general vision expressed in the

first part of the plan does not return in the rest of the POP. Aspects are handled separately, without being integrated by a central philosophy or approach. Roggema, of the province of Groningen (Appendix G), states that the visionary part is formulated with little regard to the rest of the plan and vice versa. Generally, the part which states what the policy will be is created without considering the general vision. In the process of creating the plan, first every sector – energy, nature, economy – created its own policy, and afterwards a central visionary part was added. The link between vision and policy is missing. Therefore, no integration between the various parts is created, and no long-term vision is incorporated. While the vision of Roggema may not be representative for the entire province of Groningen, it offers an interesting point of view, while being confirmed by this research.

The absence of an integrated, long-term, guiding perspective which influences all other plans offers opportunities for the adoption of this kind of approach. C2c could be an option to fill in the vacant position of central philosophy. Other aspects could also perform such a role, such as climate change. These guiding perspectives should play a role in every part of the plan, so that an integrated long-term vision is ensured.

Chapter 5: Possibilities of cradle-to-cradle in the province of Groningen

Clearly, unlike the regions of Venlo and Almere, the province of Groningen is not actively implementing c2c. The new POP does not mention the approach at all and the approaches used are not really similar to c2c. Also, the plan lacked a central long-term vision which influences every aspect of the plan. This means that the application of c2c in Groningen could make great changes, by integrating every aspect and increasing the quality of the plan. In chapter 2, the main relations between c2c and space and spatial planning were indicated; land-use, location, and a changing environmental planning were among them. However, when implementing c2c within spatial planning some more aspects come into play. These aspects include the implementation strategies, the level of scale and the regional processes to which c2c is applied. These three aspects were previously mentioned in the first chapter, and were also part of one of the questions central in this research, summarized in paragraph 1.4. Also, in chapter 3 they were the starting point for the analysis of the Venlo and Almere cases. Therefore, they provide a great basis for examining the possibilities of c2c in the province of Groningen; in the first paragraph attention will be paid to each one of them. Consequently, some conclusions will be drawn on the basis of the previous chapters, in an attempt to answer the main question of this research:
What possibilities, from a theoretical and practical point of view, are offered to the province of Groningen by the cradle-to-cradle approach in order to achieve a more sustainable spatial planning?

5.1 Implementation strategies, level of scale, and regional processes

The first of the three aspects mentioned is implementation. It is important to note that c2c does not involve intervention and government regulation, as was explained in chapter 2. According to McDonough and Braungart (2002), c2c should emerge as a result of its economical benefits rather than through government regulations. Therefore, government implementation of c2c is not an issue within the original c2c approach. However, the two main cases discussed in this research are examples of governments adopting c2c as a strategy for regional development. Also, both Venlo and Almere cooperate with the founders of c2c in implementing c2c. So the strategies used by Venlo and Almere can not be seen independently from the original background of c2c, as McDonough and Braungart themselves are involved in the process.

Within spatial planning, intervention plays an important role; several measures exist to implement the desired strategy. In Box 2.5 three different intervention strategies were mentioned: direct intervention, indirect intervention, and self-reliance (De Roo and Voogd, 2004). Direct intervention is about laws and regulations, indirect intervention involves tax privileges, disadvantages or incentives, and self-reliance stands for education and learning. The cases of Venlo and Almere provide examples where strategies are used to implement c2c in those regions. Both Venlo and Almere are currently using self-reliance strategies, such as

education and raising awareness. In Venlo, this process is guided by the local Chamber of Commerce, which is actively bringing c2c under attention of companies. Also, a local network of knowledge and contacts is created in order to attract c2c business activity, and to form a c2c community. This should offer benefits to all parties involved, in addition to attracting more c2c companies. While the activities of the Chamber of Commerce are aimed at education, the establishment of a c2c community is mainly an opportunity for mutual learning between parties involved. Both fall under the self-reliance category. No direct or indirect intervention measures are taken yet, this can be explained by the short amount of time which has passed since the start of c2c implementation in this region. As was mentioned previously in chapter 3, Lukassen (Appendix A) indicates that it is likely that certain indirect measures will be taken in the near future, such as awarding the best locations to c2c companies. Venlo is not planning to implement direct measures, such as banning all business activity which is not c2c. Lukassen states that: "nothing is stronger than the fact that the companies themselves are enthusiast about c2c", and therefore strict direct regulations do not help the process.

Almere is generally applying the same approach, rejecting direct intervention, and primarily using self-reliance. Similar to Venlo, indirect intervention strategies are not yet adopted in regulation due to the early phase of c2c implementation. But, as was indicated in chapter 3, Almere will probably use indirect intervention in the future. The strategy of self-reliance is put into practice somewhat different than in Venlo. The role of educating companies on c2c is performed by the economical department of the municipality rather than the Chamber of Commerce. Also, the creation of a network is facilitated by the establishment of a Business and Science Centre for sustainable business activity.

Even though the province of Groningen is not entirely comparable to the regions of Venlo and Almere, some things can be said about chapter 4 as well. In this chapter the new main policy document, POP, was examined. The POP showed that the province is using all three strategies; for example direct intervention in the protection of nature and landscape, indirect interventions in the financing and stimulating of sustainable energy solutions, and self-reliance in the request to companies to pay attention to certain sustainability aspects.

	Direct intervention	Indirect intervention	Self-reliance
Venlo	-	-	x
Almere	-	-	x
Groningen province	x	x	x

Box 5.1   Strategies used by the three cases

It is now relevant how this information about implementation can be translated to the possibilities of c2c in Groningen. First of all, the difference in strategies found in Box 5.1 can partly be explained by the various kinds of plans examined in this research. For Venlo and Almere no specific c2c plans were finished, so the information comes from interviews and partly finished plans; in the case of Groningen a comprehensive provincial plan was examined, which covered many more aspects and therefore includes several different strategies. Venlo and Almere also use direct intervention strategies for some aspects, such as the protection of nature and realisation of the EHS.

When considering the possible implementation of c2c in the province of Groningen, the current use of all three strategies does not seem to suit the c2c approach. C2c is about freedom and creativity rather than restrictions. The restrictions placed on developments within valuable natural areas are limiting options for other solutions, such as the c2c approach. According to the c2c philosophy, it could be that certain developments are beneficial to natural areas, and these improvements are pre-emptively excluded by using a restrictive approach. Maybe a c2c building or neighbourhood increases biodiversity by offering space for other species. Whether c2c includes improvement on a regional scale compared with other approaches is not certain.

Regarding c2c business activity, Venlo and Almere are using self-reliance in an effort to attract c2c companies and convince present companies to switch to c2c. The province of Groningen also uses self-reliance in their request to businesses to pay attention to saving energy and prevention of waste, but this measure is obligatory due to national regulation. For the province of Groningen, it remains unclear which intervention strategy gives the best result. Self-reliance strategies may fit the c2c approach best; however this does not mean that they have an optimal practical result as well. Maybe direct intervention methods result in far more increasing environmental benefits. Both the theoretical discussions and the cases of Venlo and Almere indicate that no direct intervention measures are necessary to stimulate a c2c kind of sustainable development. Of course, the effectivity of the Venlo and Almere efforts has yet to be reviewed, so no actual conclusions can be drawn on this issue. Therefore, the question of how c2c should be implemented remains difficult to answer.

The second relevant aspect is the level of scale. This is an important aspect, because the original c2c approach is micro-scale oriented, and the transformation to higher levels of scale is a recent and new practice. It is hard to say which level is most appropriate for c2c, and it is not yet clear whether c2c offers possibilities on every level of scale. It can be argued that the regional level is the most appropriate, because the local level is too small to include higher-scale processes. Consequently, the national level would be too large, because the process of reuse of materials would become too transport and energy intensive. The transport of materials for reuse on a global scale certainly does not appear to be a good idea. However, this theory can not be backed up by practices of c2c on a regional or national level. The first steps of transforming c2c from the micro-scale to local and regional scale are currently taken in Venlo and Almere. Clearly, the results of these experiments are not yet available.

In the second chapter it became clear that c2c does not specifically involve global issues, such as climate change, biodiversity loss and global wealth inequality. This is a result of the micro-scale of c2c. The transformation of c2c to a higher level of scale can solve this problem by including these aspects. The integration of various micro-scale initiatives can be a reason for implementing c2c on a higher level as well. It is now important to keep in mind that the original c2c approach was designed to fit the micro-scale, and the intended intervention strategies, being no intervention, were chosen accordingly. When transforming c2c to a higher level of scale to include high-level aspects (climate change, global wealth inequality) as well, it could be that other intervention strategies become more appropriate. After all, advocating no intervention was based on c2c on a micro-scale. It is not unlikely that for countering climate change, even direct intervention strategies are needed. This seems opposite to c2c,

however, the c2c approach has already been transformed, and it makes perfect sense to reconsider the appropriate intervention strategies as well.

Chapter 3 showed that both Venlo and Almere apply c2c on a local and a regional level of scale. The cooperation with surrounding areas should ensure coordination of regional aspects while the local implementation deals with local interests. The province of Groningen is representing the regional level, and could perhaps better be compared with the province of Limburg. Limburg is actively stimulating c2c, for which a budget of three million euro is available until 2011. It could be that Venlo and Almere policy is can not directly be translated to the province of Groningen. Provinces have other legal responsibilities and possibilities than municipalities, so it is not entirely clear whether lessons learnt from these cases are applicable at the provincial level. Which does not mean that the conclusions on Venlo and Almere are useless; they still provide valuable information, for example on the transformation of c2c towards a higher level of scale.

Thirdly, there is a clear link between the level of scale and regional processes. The level of scale of implementation of c2c determines which processes should be involved. When claiming that c2c is used on a regional level, regional processes should be included as well. Among these processes are transport, energy, water, biodiversity, and waste. The original concept of c2c did not include all of these aspects, because of the micro-scale of the approach. However, when c2c is made regional, the things to which it applies should be regional as well.

It is not yet very clear which regional aspects are included in Almere, as no plan is completely finished. In Venlo, the Masterplan Klavertje 4 indicated that five aspects are involved in the plan: infrastructure, water, energy, flora and fauna habitat, and a green environment. These aspects can be considered as the main regional processes which should be included. However, the main subject of c2c is not involved in both Venlo and Almere; waste. The reason both Venlo and Almere give for this omission is that it requires so much effort, that it is wise to first try simpler things to work, such as c2c business activity. The application of c2c on products and materials, the original intention of c2c, can be done later on.

All regional processes mentioned in this chapter are included in the new POP of the province of Groningen; infrastructure, water, energy, flora and fauna habitat, and a green environment. This should offer opportunities for c2c implementation, as all aspects are already managed by the province in one general comprehensive plan. This could make it easier to apply c2c on all of those aspects. When the general plan indicates c2c as the desired direction, all other plans could easily adapt to this ambition.

5.2 Possibilities of c2c in Groningen

Now the important aspects of c2c implementation within spatial planning are considered, more conclusions can be drawn. The main purpose of this research was to examine the possibilities of c2c in relation with spatial planning in the province of Groningen. The first main conclusion is that c2c does offer opportunities for Groningen. The main reason for this is that anything which creates this much enthusiasm always offers opportunities. The cases of Venlo and Almere illustrate the enthusiasm of both governments and businesses. Any

approach which applies to both worlds of economy and ecology should be taken seriously. Many believe economy and ecology to be two opposites which are fundamentally different, and are impossible to unite. C2c could be the first approach which is generally positively criticized by both sides, and therefore seems to bridge the gap between economy and ecology. This point is furthermore confirmed by the remarkable fact that Venlo considers c2c to be primarily an economical approach, while Almere implements c2c first and foremost as an approach to sustainability.

Also, the fact that in both Venlo and Almere major projects such as the Greenport Venlo and the doubling of the population are planned around c2c, shows that the approach should be considered realistic. Even though no conclusions can be drawn on these cases yet, they reemphasize the opportunities which are recognized in c2c. There is no reason why these opportunities would not exist in Groningen.

The major question which follows is what these c2c opportunities may be for Groningen. In this research the policy of the province of Groningen was examined. This showed that the new POP is everything but c2c, but it also showed more. The plan lacked an integrating, central vision which comes to the fore in all parts of the plan. All sectors used their own approaches and concepts, with little or no relation to other aspects discussed in the plan. Overall, no integrated vision is presented. This can be considered as a specific opportunity for c2c, because c2c does involve an integrated, widely applicable concept. This way, the new POP could be provided with a more integral vision on sustainability, which at the same time brings a positive, development-oriented imago. The case of Almere showed a similar example; Almere felt it lacked an integrated vision, next to feeling that their sector-oriented, restrictive environmental policy was old-fashioned. Therefore, Almere replaced their former policy with the progressive and integrated c2c. Paragraph 2.4 already elaborated on the change from permission planning to development planning; or from restrictive, sector-based planning to integrated, development-oriented planning. The adoption of c2c would fit this change in planning paradigm very well.

Furthermore, the new POP did already offer some more practical opportunities for c2c. For example, the province requests every company to pay attention to saving energy and other sustainability measures. Using this route, companies can easily be informed and stimulated about c2c as well. Also, municipalities are obliged to explain in their local land-use plans to what extent they involved approaches such as cascading. The same thing can be done with c2c; this way ensuring that more institutions in Groningen are aware of c2c opportunities.

A review of the specific situation of the province of Groningen and its possibilities for c2c applications does not fall within the scope of this research. So, opportunities for Groningen other than policy-related opportunities can not be specifically mentioned. However, that does not mean that nothing can be said about it. Already in chapter 2 became clear that the implementation of 'pure' c2c is not very beneficial, due to the partial and micro nature of c2c. Chapter 3 provided additional evidence for this, as both Venlo and Almere implemented an adapted version of c2c rather than sticking with the original approach. This was made even more clear by the paragraphs on how both regions dealt with c2c criticisms. The most urgent were solved by adding some elements, and most other criticisms very simple neglected. The opportunities of c2c implementation in Groningen also lie in finding the own optimal version of c2c; choosing the aspects relevant, and adding any missing elements.

Finally, when reviewing the Venlo and Almere cases, it became clear that both had very specific and legitimate reasons for applying c2c. First of all, Venlo needed something to brand the region, to attract investments and to counter the projected decline of the region. C2c offered an innovative and positive economic prospect, and therefore c2c was chosen, mainly as an economical approach. C2c was something special, which distinguished the region from others. It was primarily applied on the two sectors which were considered Venlo's main opportunities; greenhouse agriculture and logistics. Secondly, Almere wanted to change paradigm; from sector-based and restrictive to integrated and progressive policy. Also, Almere's assignment of growth to 350.000 inhabitants in 2030 offered a specific opportunity to apply something different. Moreover, the city finds its roots in sustainable and ecological concepts, due to the environmental movements in the years in which it was founded. These three aspects provide Almere's specific opportunities for c2c.

Clearly, for Venlo and Almere c2c offered obvious benefits compared to other approaches. It is crucial for Groningen to find its own benefits and opportunities, its own reasons. Of course, c2c is not a goal; rather it is a means to achieve certain goals. Therefore, c2c should only be implemented when a viable justification can be given. Some policy-related opportunities are provided by this research, however many more could perhaps be distinguished when examining the specific Groningen situation, and after evaluating the c2c efforts of Venlo and Almere in a few years. Even though neither the theoretical discussions nor the practical experiences provide bullet-proof evidence on the success of c2c, it would be short-sighted to neglect the possible opportunities offered by the c2c approach.

Chapter 6: Conclusions and Remarks

6.1   Conclusions

The goal of this research was to examine the theoretical and practical possibilities offered by the c2c approach for a sustainable spatial planning in the province of Groningen. First of all, the theoretical considerations of chapter 2 showed that c2c is not entirely new; it overlapped with various other sustainability approaches. It became clear that c2c is unique in the enthusiasm that it creates, in both economic and environmental worlds. The c2c approach can be seen as an economical as well as a sustainability approach. However, the criticisms showed that c2c does not equal sustainability. The focus is somewhat too narrow, and also high-level aspects, such as climate change and global wealth inequality, are not included within c2c. Moreover, chapter 2 showed that the level of scale is very important within c2c implementation. C2c at the smallest scale does not include high-scale stakes, while c2c at a global level for example would be very inefficient in the transportation of materials over huge distances. The regional scale seems to provide a good alternative. Also the manner in which it is implemented could play a role in the success of c2c within spatial planning. The original c2c approach argues in favour of abolishing regulations and interventions. However, this is in contrast with the nature of spatial planning, which is concerned with intervention. Also, the transformation of c2c to a higher level of scale may result in the need for other intervention strategies compared to the original, micro-scale c2c approach.

The cases of Venlo and Almere showed possible ways to implement c2c. Due to the recent nature of c2c efforts in these regions, no conclusions could be drawn on the success or failure of these efforts. Both regions proved to be quite similar in their efforts, as they tried to use the enthusiasm surrounding c2c. An important difference is the reason for adopting c2c. Venlo aims to use the innovative, positive nature of c2c to brand the region as attractive, in order to counter the expected decline in population. Almere mainly adopted c2c to change paradigm in their environmental policy; from sector and restrictions-based towards integrated, and development-oriented, positive policy. So, in both regions the positive nature of c2c played an important role. Both regions aim at attracting c2c companies, by self-reliance methods, such as education and mutual learning. No financial or locational advantages are offered by the regions to c2c businesses. Furthermore, Venlo and Almere did not implement the original c2c approach, rather they created their own version of c2c, customizing it to fit the local needs. An interesting result of this is that both regions do not include one of the main points of c2c in their efforts: applying c2c on everyday products. Whether their efforts can still be called c2c is questionable, because the approach is considerably altered. However, as the founders of c2c are in both cases involved, it is hard to state that Venlo and Almere are not c2c. So, these regions show that c2c does not need to be implemented in a rigid way; it makes sense to adapt the approach to fit a specific situation. Although no conclusions can be drawn on these cases, they provide examples to Groningen on how the c2c approach can be put into practice.

When considering the opportunities for c2c in the province of Groningen, it is relevant to examine current provincial policy on c2c contents. The new POP, the main provincial document on spatial planning, did not mention the words cradle-to-cradle, and proved not to

involve c2c strategies as well. About 39% of the POP ambitions seemed to reflect c2c philosophy, but after thoroughly examining the more specific parts of the plan, it proved that the plan is not anything close to similar to c2c. Next to this conclusion, it became clear that the plan lacked an integrated vision which connected every part of the plan. The various sectors used their own specific strategies without including aspects of a central philosophy. When a main approach would be added to the POP, this would improve the quality of the plan. One of the possible concepts which could perform this role is c2c.

When considering the possibilities of c2c for a sustainable spatial planning in the province of Groningen, it becomes clear that the approach offers several opportunities. The main reason for this is that c2c creates enthusiasm among both businesses and environmentalists. The regions of Venlo and Almere prove that this enthusiasm is not only present in McDonough and Braungart's 2002 book, but exists in practice as well. Any approach which is this well-received should always offer opportunities. For Groningen, these include both policy-related and area-specific opportunities. The former include the lack of a central vision in the POP, and the adaptation of some existing policies. The latter were not examined in this research, yet some things can be said about them. Groningen should not implement 'pure' c2c; rather they should create their own optimal version of it. This means applying the approach to the processes considered appropriate by Groningen, as well as using the corresponding intervention strategies. The question remains to what extent such an effort can still be termed c2c, however, Venlo and Almere showed that c2c can be widely interpreted. Finally, it is most important for Groningen to find its own area-specific possibilities, similar to the way Venlo and Almere have found theirs.

One question now remains; this is the last sub question mentioned in chapter 1: *What added-value does c2c have for the province of Groningen and how can the approach be successfully implemented?*
The answering of this question would involve an assessment of the effectivity of current Groningen policy, something which was not part of this research. C2c is not easily comparable with the current policy; this would perhaps require a complete new research. However, it is likely that the added-value of the c2c approach lies in its integrated, positive nature. It could be used as a complementary approach to current POP approaches, while stimulating positive developments in both the economical and ecological world. The quality of the plan should be increased by applying an integrative approach, improving the relations between various policy fields. However, once again it becomes clear within this answer that c2c is in its very early stages on the area on regional spatial planning. The added-value which the c2c approach may have compared to current POP policy simply is still quite unclear. The current policy may work perfectly fine as well. The most successful way of implementation is also not entirely clear yet. The cases of Venlo and Almere could maybe give more comprehensive answers in a few years, when their results become visible. In that period the added-value of c2c can also be evaluated in more detail.

6.2   Remarks and recommendations
As a final note, some remarks and recommendations will be made on this research in this last paragraph. Mostly, they are a result of the fact that this research was done within a certain

timeframe, and it therefore may not be as comprehensive as it could have been. Also, some ambiguity may have risen during the last chapters, and this paragraph should function to clarify some final issues.

Throughout this research the term c2c has been used very widely. The problem with this is that it has become somewhat unclear what exactly c2c is. The concept was introduced as it was originally intended by the 2002 book by McDonough and Braungart. Most of the critique was aimed at this version of the c2c concept. However, both McDonough and Braungart made comments on the original approach and this way a new version of c2c emerged. This new version was less extreme and dealt with several of the criticisms. At this point, some questions became harder to answer, such as: does c2c intend the whole world to become c2c? The original approach indeed seems to strive for an application of c2c as wide as possible. The adapted c2c, however, was quite subtle regarding to what extent c2c can be useful. Braungart indicated in chapter 2 that it was not about "everything being perfect". In chapter 3 the concept became even more blurred, as Venlo and Almere came up with their own versions of the concept. These versions significantly differed from the original approach, but both regions still named it 'c2c'. What added to the ambiguity of the situation, was that McDonough and Braungart themselves were involved with the Venlo and Almere plans. So, these plans which were different from c2c, were in fact co-designed by the original founders of c2c. At this point, various versions of c2c exist, which makes it increasingly hard to describe precisely what c2c is. Of course, some main principles of c2c can be distinguished, which appear in every version of c2c. These aspects include the aim of closing flows of materials and abandoning the cradle-to-grave system. They could be named as the essential c2c characteristics, while others such as the abolishment of regulations can be considered as aspects which are not crucial within c2c.

Another point of interest which has come to the fore shortly at several occasions in this research is the paradox of spatial planning and c2c. C2c is essentially an approach which is business-oriented rather than government-oriented. As explained earlier, c2c aims at companies voluntarily switching to c2c because it offers economical benefits. All government regulation should be abolished, because of its restrictive nature. Essentially, with these statements, c2c rejects the concept of spatial planning, as planning is about intervention and government regulation. So, the natures of spatial planning and c2c are opposite to each other. This implies that spatial planning and c2c could never be combined; something which is proven false in Venlo and Almere. However, when implementing c2c within planning, it could create some ambiguity, as c2c originally intends to work without government. This came to the surface when discussing the casestudies and the possible implementation strategies. Of all three intervention strategies, self-reliance is most similar to c2c, and therefore it makes sense that both cases use this approach. However, when they are also implementing indirect intervention strategies, as is planned for the future, the question arises how compatible with c2c this is. Clearly, spatial planning may not always involve the same goals and strategies as the c2c approach.

The analysis which took place in this research was somewhat limited by the fact that c2c in the Netherlands has just started. The processes proved to be in the early stages, and therefore less conclusions could be drawn. This is exemplified by the fact that the region which has proceeded the farthest, Venlo, has not yet laid down c2c in their own official policy

(Appendix A). As a result, the casestudies are not as in-depth as they might have been otherwise. A logical step would have been to study some c2c cases abroad. However, the problem is that no relevant cases could be found; various examples of c2c applications exist, but none of them were dealing with c2c on the regional level. The examining of cases on the micro-scale was of little use for this research. It seems that Venlo and Almere are truly pioneering in their attempts to upscale c2c to fit a higher level of scale.

Moreover, due to this lack of official policy, the interviews with relevant employees of the municipalities became much more important. This way, factual policy was replaced by more personal interviews, which means an increasing role for the point of view of the interviewed person. This could for example result in an incomplete picture of the c2c efforts. Requesting these people that they will answer in a way which is representative for the entire municipality or province is the most logical solution. Consequently, the research remains dependent on one main source. Some additional documents were used, but these were mainly the result of very early stages of implementation and were not always up-to-date. Still, the persons responsible for the interviews should represent their municipality in the best possible way. Therefore, it is both attractive to be comprehensive, as well as it is attractive to be positive about the municipal efforts. So, it would have been extra useful to be able to examine the results of Venlo and Almere's c2c efforts. This way, some personal views would have been replaced by factual conclusions, which adds to the quality of the research.

Another drawback from the lack of policy is that there is no guarantee that c2c will actually be used intensively. Maybe all visionary ambitions expressed in the interviews will not even be translated into policy. It could be that following elections a sudden change in direction will take place, and c2c runs out of favour. As long as no policy is formulated, there is no guarantee that the c2c approach will actually play an important role.

One final consequence of the recently emerged popularity of c2c is that not much literature is available on the subject yet. Although the book on c2c appeared already in 2002, few scientific journals or newspapers have paid attention to the approach since. Only from 2007 on, c2c is becoming more commonly known in the Netherlands, and as a consequence the amount of articles on c2c remains somewhat limited. Most of the articles used in this research were written in 2007 and 2008, so the last years the amount of knowledge on c2c is growing. Still, this research could be more comprehensive if more discussions and scientific debate would have been available.

For these reasons mentioned above, such as the early stages of c2c implementation, and the personal view of the persons interviewed, it would be relevant to study these cases again in a few years. This could be very interesting, as more conclusions can be drawn on the success or failure of certain measures. This will be a valuable addition to this research.

Furthermore, something which was not included in the scope of this research, are the specific provincial incentives for c2c measures in Groningen. These could be the decline in population in certain regions, energy potentials, or maybe climate change. It is important to further examine these opportunities, in order to come to an even more comprehensive conclusion on the question what the possibilities of c2c implementation in Groningen are.

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