



Flanders
State of
the Art

PUB. N°

3

**CE CENTER
CIRCULAR
ECONOMY**

POLICY RESEARCH
CENTRE

WE MAKE
TOMORROW
BEAUTIFUL
OVAM

DEPARTMENT OF
ECONOMY
SCIENCE &
INNOVATION

Employment impact of the transition to a circular economy

ce-center.be



CE CENTER CIRCULAR ECONOMY

POLICY RESEARCH
CENTRE

Employment impact of the transition to a circular economy

Gwen Willeghems
Kris Bachus

Research Group Sustainable Development, HIVA, KU Leuven
Parkstraat 47 bus 5300, 3000 Leuven, Belgium

September 2018

CE Center publication N° 3

PUB. N°

3

Contact information:

Luc Alaerts

manager Policy Research Centre

✉ luc@vlaanderen-circulair.be

☎ +32 16 324 969

Karel Van Acker

promoter Policy Research Centre

✉ karel.vanacker@kuleuven.be

☎ +32 16 321 271

Table of Contents

List of Figures.....	3
List of Tables.....	4
Summary	5
Samenvatting.....	6
1. Introduction	7
2. Conceptual framework of the circular economy framework	8
3. Employment effects of the circular economy.....	13
3.1. Methodologies to analyse employment effects.....	13
3.1.1. Qualitative analysis	13
3.1.2. Quantitative analysis	13
3.1.2.1. Accounting models	13
3.1.2.2. Input-output modelling	14
3.1.2.3. Computable General Equilibrium (CGE) analysis	14
3.1.2.4. Macro-econometric models	14
3.2. Prelude - technology and automation.....	14
3.3. General CE employment effects.....	15
3.4. Innovation and circular design	21
3.5. Reduce	21
3.6. Reuse	22
3.7. Recycle	23
3.8. Sharing economy	24
3.9. Performance economy (servitization)	25
3.10. Overview	26
4. The labour market in Flanders.....	27
4.1. Characteristics of the unemployed in Flanders.....	27
4.2. CE employment per NACE sector	33
4.3. Labour market mismatches	40
4.3.1. Educational mismatch	41
4.3.2. Geographical mismatch	43
4.4. The changing position of low-skilled labour on the labour market	45
5. Conclusion and discussion	48
Bibliography.....	50

List of Figures

Figure 1. Circularity ladder, adapted by the authors from De Groene Zaak (2015), yellow boxes represent areas with employment opportunities mostly for vulnerable groups.	10
Figure 2. Unemployment rate (in %) per province (red bars) recorded in January of each year from 2000 to 2014. The grey bars represent the Flemish average.	27
Figure 3. Number of non-working job seekers in Flanders per skill level, recorded in January of each year from 2000 to 2017.	28
Figure 4. Number and ratio of non-working job seekers in Flanders per province and skill level, recorded in January of each year from 2000 to 2017. The grey bars represent the Flemish average.	29
Figure 5. Percentage of non-working job seekers in Flanders per skill level and period of unemployment, recorded in January of each year from 2000 to 2017.	30
Figure 6. Percentage of non-working job seekers in Flanders per age category and period of unemployment, recorded in January of each year from 2000 to 2017.	30
Figure 7. Percentage of non-working job seekers in Flanders per origin and skill level, average for 2016.	31
Figure 8. Percentage of disabled non-working job seekers in Flanders per skill level, compared to the total amount of job seekers per skill level, recorded in January of each year from 2000 to 2017.	32
Figure 9. Percentage of disabled non-working job seekers in Flanders per skill level, compared to the total amount of disabled non-working job seekers, recorded in January of each year from 2000 to 2017.	33
Figure 10. Personnel cost overview for relevant CE NACE sectors for Belgium. Empty bars represent missing data.	35
Figure 11. Overview of number of enterprises and employees for the relevant CE NACE sectors for Belgium. Empty bars represent missing data.	35
Figure 12. Gender ratio for the relevant CE NACE sectors for Flanders.	36
Figure 13. Age ratio for the relevant CE NACE sectors for Flanders.	37
Figure 14. Occupation ratio per NACE sector (as % of people per occupation type) for Belgium in the year 2016. Colour scales indicate high wage (blue), mid-wage (pink) and low wage (green) occupations.	39
Figure 15. Overview of received and open vacancies per skill level for the 'energy, water and waste processing' sector per province from the year 2010 to 2016.	44
Figure 16. Breakdown of geographical location of jobs as per place of residence for the year 2010 (in % of the total employment exercised in each province).	45
Figure 17. (Predicted) evolution over time of the employment growth rate per skill level for Belgium.	Error! Bookmark not defined.

List of Tables

Table 1. Potential skill needs by circular economy activity.	18
Table 2. Potential geographical dispersion of jobs by circular economy activity.....	19
Table 3. Literature overview employment in the circular economy.	26
Table 4. Overview of the relevant NACE code divisions and their description.	34
Table 5. Overview of the abbreviations used in Figure 10 and Figure 11.	34
Table 6. Overview of the abbreviations used in Figure 14.	39
Table 7. Overview of the number of job vacancies received by VDAB and the number of bottleneck vacancies per occupation type for the year 2015 for Flanders.	42
Table 8. Overview of skill levels in Flanders.....	46

Summary

Framed within the [Flemish policy research centre Circular Economy](#), this research paper is the first output of the research line that studies employment and actor analysis for the circular economy (RL 6).

The objective of this study was to gain insight in how the transition to a more circular economy could impact the labour market, with a focus on net job creation or loss, job creation at different skill levels, and geographical job concentration. The methodology used was a combination of literature review and exploratory data analysis, the latter mainly focused on the Belgian region of Flanders.

As many different definitions exist that describe “circular economy”, a combination of concepts was chosen to investigate the impact on the labour market.

The literature review showed that, when it comes to the quantification of job impacts, different methodologies can be used. Moreover, generally speaking, studies quantifying the job impact of the circular economy forecast a net increase in jobs, although some existing jobs might be lost. Next to quantitative estimates, a number of qualitative estimates have been published on job creation through the transition to a circular economy. More specifically, depending on the type of action contained within the “circular economy”, i.e. reduce, reuse, and recycle, the impacts of a “more circular economy” vary for the different levels of skilled labour (low, medium, high-skilled) and geographical location (local, regional, global). Additionally, while certain existing occupations might be lost, new occupations might be created (job substitution and job creation), or similar changes might occur at the job activity level where some specific tasks might be replaced by others (job transformation). Similar developments occur due to technology changes and robotization. Finally, the impact of circular design and innovation on the labour market depends on the area in which the innovation occurs. Innovation that creates new demand generally generates new employment, while end-of-pipe innovations usually go hand in hand with labour-saving technologies.

Focusing on the labour market characteristics in Flanders, the exploratory data analysis indicated that the group of non-working job seekers is disproportionately made up of low-skilled labour and other vulnerable groups, such as older workers, long-term unemployed, non-natives and people with an occupational disability. Combining this analysis with the results from the literature review, we expect that a transition to a more circular economy will positively affect employment for these vulnerable groups and reduce overall unemployment. Moreover, the transition has the potential to reduce the educational and geographical mismatches currently present in the Flemish labour market. However, the specific impact on vulnerable groups depends on the specific opportunities of the circular economy in Flanders, which might be different from opportunities in other countries and regions. It is also important to not only look at the number of jobs that can be created but also the quality of these jobs. The research that has been conducted so far indicates that some jobs in the waste sector are 'dirty jobs'. More research into working conditions in circular economy jobs is hence needed.

Samenvatting

Dit onderzoeksrapport, gekaderd binnen het [Steunpunt Circulaire Economie](#), is de eerste output van de onderzoekslijn die de werkgelegenheid en de actoren in de circulaire economie bestudeert en analyseert (OL 6).

Het doel van deze studie was om inzicht te krijgen in de manier waarop de transitie naar een meer circulaire economie de arbeidsmarkt kan beïnvloeden, met een focus op netto jobcreatie of -verlies, jobcreatie op verschillende vaardigheidsniveaus en geografische jobconcentratie. De gebruikte methodologie was een combinatie van literatuuronderzoek en verkennende data-analyse, waarbij die laatste zich vooral richtte op de Belgische regio Vlaanderen.

Omdat er verschillende definities bestaan die de 'circulaire economie' beschrijven, werd een combinatie van concepten gebruikt om de impact op de arbeidsmarkt te onderzoeken.

Uit de literatuurstudie bleek dat verschillende methodologieën kunnen worden gebruikt om de impact op tewerkstelling te kwantificeren. Verder voorspellen studies die de banenimpact van de circulaire economie kwantificeren over het algemeen een netto toename in jobs, hoewel sommige bestaande jobs mogelijk verloren gaan. Naast kwantitatieve schattingen zijn er ook een aantal kwalitatieve schattingen gepubliceerd over jobcreatie door de transitie naar een circulaire economie. Meer specifiek, afhankelijk van het type actie in de "circulaire economie", d.w.z. verminderen ("reduce"), hergebruiken ("reuse") en recycleren ("recycle"), variëren de effecten van een "meer circulaire economie" voor de verschillende niveaus van geschoolde arbeidskrachten (laag, midden, en hooggeschoold) en geografische locatie (lokaal, regionaal, wereldwijd). En, terwijl bepaalde bestaande beroepen mogelijk verloren gaan, kunnen nieuwe beroepen gecreëerd worden of kunnen gelijkaardige wijzigingen optreden op het jobtakenniveau, waarbij sommige specifieke taken door anderen kunnen worden vervangen (job transformatie). Vergelijkbare ontwikkelingen doen zich ook voor als gevolg van technologische veranderingen en robotisering. Ten slotte hangt de impact van circulair design en innovatie op de arbeidsmarkt af van het gebied waarin de innovatie plaatsvindt. Innovatie die nieuwe vraag creëert, genereert over het algemeen nieuwe werkgelegenheid, terwijl end-of-pipe-innovaties meestal gepaard gaan met arbeidsbesparende technologieën.

Als we de focus verplaatsen naar de kenmerken van de arbeidsmarkt in Vlaanderen, toonde de verkennende data-analyse aan dat de groep niet-werkende werkzoekenden onevenredig is samengesteld uit kortgeschoolde arbeid en andere kwetsbare groepen, zoals oudere werknemers, langdurig werklozen, allochtonen en mensen met een arbeidsbeperking. Door deze analyse te combineren met de resultaten van de literatuurstudie, verwachten we dat de transitie naar een meer circulaire economie de werkgelegenheid voor deze kwetsbare groepen positief zal beïnvloeden en de totale werkloosheid zal verminderen. Bovendien heeft de overgang het potentieel om de huidige educatieve en geografische mismatches op de Vlaamse arbeidsmarkt te verminderen. De specifieke impact op kwetsbare groepen hangt echter af van de specifieke kansen van de circulaire economie in Vlaanderen, die kunnen verschillen van de kansen in andere landen en regio's. Ook is het belangrijk niet alleen te kijken naar het aantal jobs dat gecreëerd kan worden maar ook de kwaliteit van deze jobs. Uit het onderzoek dat tot nu toe verricht werd bleek dat sommige jobs in de afvalsector 'dirty jobs' zijn. Meer onderzoek naar arbeidsomstandigheden in circulaire economie jobs is dus nodig.

1. Introduction

The transition to a more circular economy has, next to an ecological and economic impact, important social effects. The labour market, for one, will (have to) adapt to the new reality, and anticipating this change at an early stage will result in a better outcome.

It is important to develop the knowledge, skills and competences that are required to enable and implement a transformation in the current production and consumption processes. The timely identification of these new needs is essential in order to support and effectively manage the transition process (Bachus et al., 2016).

In this report, we explore how the CE transition will impact the labour market, what the subsequent effects will be, and which needs will arise. The methodology used is a combination of literature review and exploratory data analysis.

The main research question of this report is how a transition to a more circular economy will impact employment, and, more specifically, net job creation, opportunities for different skill levels and geographical job concentration. By means of collecting and summarising existing publications and conducting an exploratory analysis on Flemish labour market data we provide a general idea of what this CE transition might look like in Flanders. Therefore, we break apart the main research question into a number of specific questions which we answer in this report:

- How can we define the concept “circular economy” to best suit our specific research needs?
- How does the transition to a more circular economy affect the labour market and how can this impact be measured?
- Which publications have already dealt with this issue and what can we learn from them?
- What are the characteristics of the labour market in Flanders and how will it be affected by a CE transition?

The report consists of several sections, each answering a specific research question defined above. Section 2 enters more deeply into the “circular economy” concept. Then, Section 3 zooms in on the potential impact of a more circular economy on the labour market, bringing together methodology and an overview of the effects of a more circular economy on the labour market, focusing on job creation and potential future skills needs and changes. Section 4 uses exploratory data analysis to get an understanding of the Flemish labour market in general, of the main characteristics of employment in the “circular” economic sectors, and of difficulties in matching labour supply and demand. Finally, Section 5 formulates a short overall conclusion of the literature review.

2. Conceptual framework of the circular economy framework

In this section, we provide a short overview of the work that has been conducted around the concept of “circular economy”. Based on this overview, we define a conceptual framework which we will use for the analysis in this report.

The Ellen MacArthur Foundation, a charity that works with business and education to accelerate the transition to a circular economy (CE), defines the CE as “an industrial system that is restorative or regenerative by intention and design” (2013, p. 7). As a consequence, waste is “designed out”; becoming a resource, and consumers become users. More specifically, the Ellen MacArthur Foundation states that value is created by minimising materials usage, extending the life-cycle of products by reuse – and diversifying this reuse across the value chain-, remanufacturing and recycling (Ellen MacArthur Foundation, 2013).

The objective of promoting a transition to a circular economy is to decouple environmental pressure from economic growth and its origins can be traced back to ecological and environmental economics and industrial ecology. The implementation of CE has so far mainly focused on the activity of recycling. For instance, in 2016, 65.6% of the total amount of collected household waste in Flanders was either recycled or composted (Openbare Vlaamse Afvalstoffenmaatschappij, 2017). At the European and worldwide level, in 2005, the overall recycling rate¹ amounted to 41 and 28% respectively² (Haas et al., 2015). For that same year, the recycling rate within the economy as share of processed material was 6 % worldwide and 13% at EU level (Haas et al., 2015) while the average growth rate of material consumption in the last decade (1950-2010) amounted to 3.6% (Schaffartzik et al., 2014). These numbers indicate that, while important results have been achieved in the waste sector, the transition to a CE worldwide is assumed to be in its early stages (Ghisellini et al., 2016; Haas et al., 2015). According to Haas et al. (2015), the cause for this low level of circularity is the fact that 44% of processed materials is used to provide energy and is, hence, unavailable for reuse or recycling; combined with the fact that a very large fraction of materials accumulates as in-use stocks.

Besides the CE definition developed by the Ellen MacArthur Foundation, many others exist (Ghisellini et al., 2016; Kirchherr et al., 2017) and, up to date, no single definition has been generally accepted (Organization for Economic Cooperation and Development, 2017). The reason for this is that the concept of “circular economy” is used by a variety of stakeholders operating in different areas of research and society who all have developed different interpretations of the same concept (Blomsma and Brennan, 2017). Therefore, we provide a short overview of those CE concepts that are most relevant to better understand the aspect of employment, and more specifically, low-skilled employment in the circular economy. Based on this overview, we propose our own conceptual framework (presented in Figure 1), which will be used for the remainder of the study as a guideline upon which we focus our analysis.

¹ This rate is calculated based on 47 material groups as defined by the Eurostat classification of material flow accounts (Eurostat, 2012). The main material groups are biomass, fossil fuels, metals, waste rock, and industrial and construction minerals.

² According to Eurostat, for Belgium, 87.7% of the total waste was recycled and reused in 2006.

Over the past years, multiple reviews on the concepts and definitions surrounding the circular economy have been published (Blomsma and Brennan, 2017; Geissdoerfer et al., 2017; Ghisellini et al., 2016; Kirchherr et al., 2017; Lewandowski, 2016). In the literature, the concept of CE mainly emerges through three main “actions”, i.e., the so-called 3R's principle: Reduction, Reuse and Recycle (Feng and Yan, 2007; Ghisellini et al., 2016; Ren, 2007; Sakai et al., 2011). This principle is based on the waste hierarchy or “Lansink’s Ladder”, developed by Ad Lansink in 1979. This hierarchy consists of 6 steps, namely (in order of decreasing level in the hierarchy), reduce, reuse, recycle, energy, incineration and landfill, and, while it seems to be a linear concept, it is in fact a sequence of circular processes (Lansink, 2017). The reduction principle aims to “minimize the input of primary energy, raw materials and waste through the improvement of efficiency in production and consumption processes” (Ghisellini et al., 2016, p. 15). The reuse principle refers to “any operation by which products or components that are not waste are used again for the same purpose for which they were conceived” (European Commission, 2008, p. 312/10), and the recycling principle to “any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other processes” (European Commission, 2008, p. 312/10). Moreover, Ghisellini et al. (2016) add three additional elements to the 3R’s principle, namely appropriate design, a reclassification of materials into “technical materials” and “nutrients”, and “renewability”. The European Commission (2008) defines eco-design as “the systematic integration of environmental aspects into product design with the aim to improve the environmental performance of the product throughout its whole life cycle”.

Wijkman and Skånberg (2015) discern different key steps in a circular economy: enhancing energy efficiency, increasing the percentage of renewable energy in the energy mix, and organizing manufacturing along the lines of a materially efficient circular/performance-based economy. This last step can be achieved by using materials more efficiently, by enhancing the use of secondary materials, and by doubling the product-life of consumer goods and is very similar to the 3R’s principle described above. It is also the step we will focus on in this study.

Then, in the framework of improving material efficiency, Bocken et al. (2016) developed a categorization of linear and circular approaches for reducing resource use, based on Stahel (1982), McDonough and Braungart (2002), and Braungart et al. (2008). These approaches consist of (i) slowing resource loops (e.g. the design of long-life goods and product-life extension), (ii) closing resource loops (e.g. recycling), and (iii) narrowing resource flows or resource efficiency (i.e., using fewer resources per product), and are also very much related to the 3R’s principle.

Based on the different concepts and definitions, we have adapted the “circularity ladder”, developed by De Groene Zaak (2015), to Figure 1 below. The “circularity ladder” is based on the existing waste hierarchy first defined by Lansink (i.e. Lansink’s Ladder) and later taken up by the European Commission (European Commission, 2008) and connects it to the strategies described by, amongst others, the Ellen MacArthur Foundation, such as circular design and refurbishment; new business models, such as the performance and sharing economy; and the geographical dimensions at which these processes primarily take place. Figure 1 presents circular actions (blue boxes), based on the 3R’s principle. Each action contains a number of activities. The increasing degree of circularity is presented by the green arrows, from right to left for the actions, and from bottom to top for the activities. The yellow boxes represent activities with employment opportunities mostly addressing low-skilled workers. To clarify what these activities entail we provide a description for each of them.

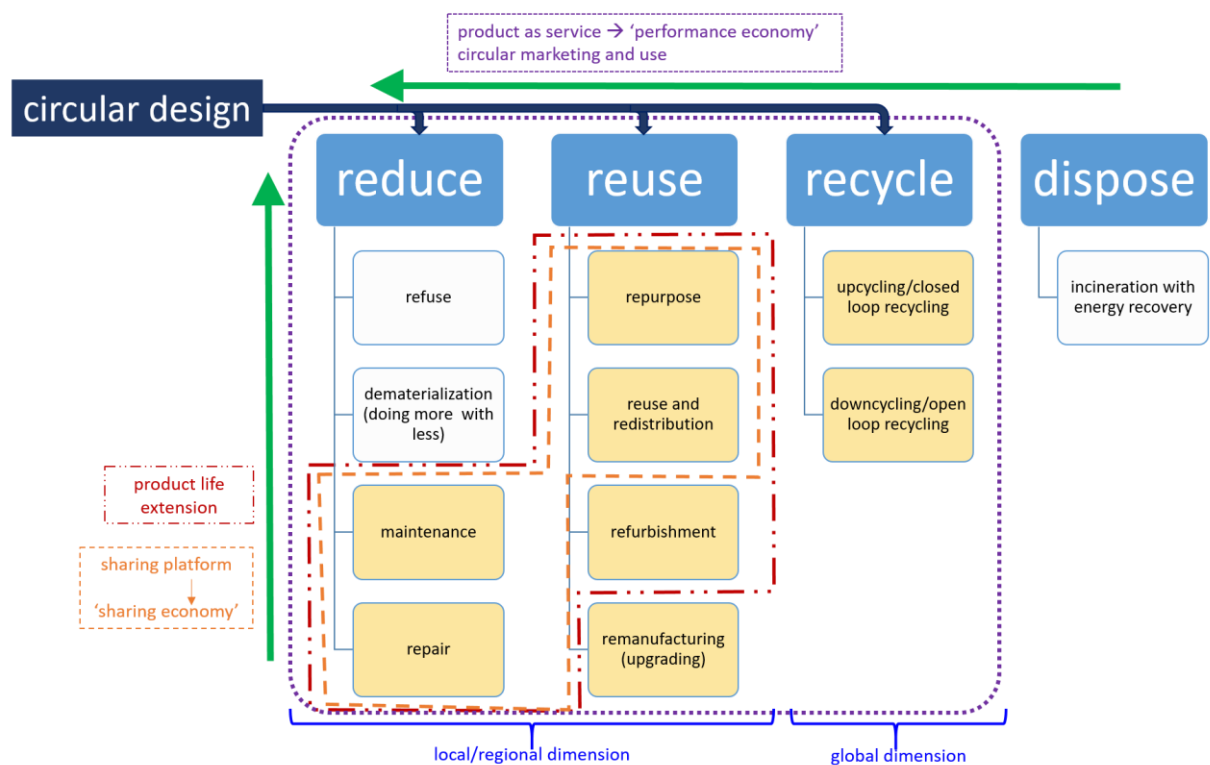


Figure 1. Circularity ladder, adapted by the authors from De Groene Zaak (2015), yellow boxes represent areas with employment opportunities mostly for vulnerable groups.

- *Refuse, dematerialization, sufficiency:* these activities focus on moderating product consumption by reducing demand. Sufficiency is defined as “reducing absolute demand by influencing and mitigating consumption behaviour”, and “encouraging consumers to make do with less” (Bocken and Short, 2016, p. 42), i.e. focusing on satisfying “needs” rather than promoting “wants”.
- *Maintenance:* this is a critical activity carried out in the use phase of the product life cycle and the most efficient way to retain or restore equipment to its desired level of performance (Circular Economy Toolkit, n.d.) and extend its product life. An example within the CE framework is the maintenance of electric equipment to extend product-life, such as decalcifying the water kettle.
- *Repair:* this means restoring something damaged, faulty, or worn to a good condition (Oxford Dictionary), for instance, the repair of electrical and electronic devices. A specific example is the online global repair community [iFixit](#) that combines open-source manuals for repairing goods with a sales platform for tools and spare parts. The global [repair café movement](#) is another good example.
- *Repurpose:* this refers to the use of a product or material for a different function than it was originally produced for (Circular Economy Practitioner Guide, n.d.). For instance, in 2016, Google was reported to have plans to repurpose an old, shutdown coal plant in Alabama into a data centre. An already present network of transmission lines in the coal plant meant that Google would not have to build its own transmission lines (Grady, 2016).
- *Reuse and redistribution:* this means “any operation by which products or components that are not waste are used again for the same purpose for which they were conceived”

(European Commission, 2008, p. 312/10). In Flanders, there is a territory-wide network of [reuse shops](#) operated by social economy organizations.

- *Refurbishment*: A “process of returning a product to good working condition by replacing or repairing major components that are faulty or close to failure, and making ‘cosmetic’ changes to update the appearance of a product” (Ellen MacArthur Foundation, 2013, p. 25). For instance, Philips refurbishes healthcare products to offer medical facilities access to high quality systems within budget, such as fully refurbished magnets for MRI systems (Philips Healthcare, 2014).
- *Remanufacturing*: this is the “process of disassembly and recovery at the subassembly or component level. Functioning, reusable parts are taken out of a used product and rebuilt into a new one” (Ellen MacArthur Foundation, 2013, p. 25). Analyses suggest remanufacturing saves at least 70% of the materials required to manufacture new goods (Morgan and Mitchell, 2015a). An example of remanufacturing can be found in the tire sector. Tires can be remanufactured by being re-treaded. This means that the basic inner core of the tire is retained and remaining tread cut off, while new rubber is applied and bonded to the core (Inc.com, n.d.).
- *Upcycling*: “Upcycling or closed loop recycling involves using waste to make new products without changing the inherent properties of the material being recycled. It can also cover recycling where the product changes but the quality of the material is maintained” (Morgan and Mitchell, 2015a). Many examples exist and upcycling can easily be done at home. A number of websites³ are dedicated to upcycling and provide a lot of suggestions for DIY upcycling. For instance, worn-out bicycle tires can be turned into belts for trousers.
- *Downcycling*: “Downcycling or open loop recycling uses recovered materials to create products that have lower value compared to those produced in closed loop recycling” (Morgan and Mitchell, 2015a. p.4). A well-known example is the downcycling of plastics. Plastic bottles and other plastic products are collected for recycling and turned into lower quality products, such as flowerpots and outdoor playground equipment.
- *Biorefining*: This activity is not specifically present in the scheme but is mentioned nevertheless as circular activities also apply here. Biorefining implies the extraction of small quantities of valuable materials (such as proteins or speciality chemicals) from bio-waste, or the conversion of waste into energy, for instance through anaerobic digestion, or composting (Morgan and Mitchell, 2015b). These activities revalorise biological waste into products that are worth more than the original waste. For instance, the [GeNeSys](#) project by ILVO, the Flemish Institute for Agriculture and Fisheries, researched applications that could add value to residual fractions in animal and vegetable production.

Next, we identified a number of crosscutting themes that address activities at different action levels.

- *Circular design*: Design plays a crucial role in the economy and influences all actions and activities mentioned in Figure 1. In manufacturing processes, it has the lowest ratio of cost but the highest level of influence. Circular design is design that aims for maintenance, repair and durability; modularity, disassembly, upgradability, recyclability and adaptability; extended producer responsibility and transparency. It entails a

³ Such as [Upcycle that](#), [The upcycle movement](#), [Hip Cycle](#), and [Recyclart](#).

systems approach and pursues value creation and innovation. It views sustainability as an economic opportunity (De Groene Zaak and Ethica, 2015).

- *Performance economy, (functional) service economy or 'servitization'*: As a new business model, the performance economy aims at selling performances or services instead of products, hence postponing the consumption of assets (Morgan and Mitchell, 2015a; W. R. Stahel, 2010). A well-known example is the 'Michelin Fleet Solutions', a customised tire leasing programme where lorry fleet operators pay for services at prices per mile instead of buying the actual truck tyres (Michelin, n.d.).
- *Circular marketing and use*: A transition to a more circular economy implies a transition to an increase in reduce, reuse and recycle. When it comes to marketing, this transition means that the relationship between a customer and a company will change. Marketeers will have to think differently about the concepts of identity and desire, loyalty and reward, and trust and transparency. They have the important role of educating customers about quality and value and showing them the benefits of circular products (Lovett, 2014).
- *Product life extension*: Product life extension refers to extending the lifespan of a specific product through longer product life, refurbishment and remanufacturing (Bakker et al., 2014). These issues should be addressed during the design phase.
- *Sharing economy, platform or collaborative economy*: This is another new business model. According to Codagnone and Martens (2016, p. 11), the sharing economy is "a very heterogeneous group of platforms that contains many new and very innovative economic and social activities that are hard to classify". The European Commission (2016, p. 3) defines the sharing economy as "business models where activities are facilitated by collaborative platforms that create an open marketplace for the temporary usage of goods or services often provided by private individuals". Transactions in the sharing economy usually do not involve a change of ownership and can be carried out for profit or not-for-profit. Ample examples exist, such as crowdfunding (e.g. [Kickstarter](#)) apartment or house renting (e.g. [Airbnb](#)), ridesharing or car sharing (e.g. [Blablacar](#)), [Peerby](#), co-working, etc.

Finally, we make the distinction between actions and activities that have a more local or regional dimension, such as activities related to reduce and reuse, and those that take place on a more international or global scale, such as recycling (Morgan and Mitchell, 2015a; Walter R. Stahel, 2010). When we look at employment effects of the transition to a more circular economy, it is important to keep these dimensions in mind as they will determine where job creation (or job loss) might occur (see also Section 3.3).

3. Employment effects of the circular economy

In this section, we present the insights of a literature review on the nature of job creation in the circular economy and on the possible future developments of circular economy activities and their labour requirements. The literature that is discussed here assumes different scenarios in which the transition to a circular economy has been realised. We use Figure 1 as the basis for this overview and discuss the main results of the literature review for each step of the circular ladder as well as general CE employment effects. A summary of the publications that tackle employment in specific segments of the CE concept can be found Table 3 in Section 3.10. After this more general overview, we move to explore the Flemish case based on literature and relevant statistics in Section 4. The Flemish case description is based on the current situation where we are still at the take-off stage of the transition to more circular economy.

Before we present the results of the literature review, we explain the different methodologies currently used to assess employment impacts.

3.1. Methodologies to analyse employment effects

Employment effects can be researched and analysed in different ways, using different methodologies, depending on the research questions that needs to be answered. In this section, we provide a short overview of the methodologies that have already been used to conduct these analyses.

3.1.1. Qualitative analysis

A qualitative analysis is conducted by literature analysis and expert interviews.

3.1.2. Quantitative analysis

A quantitative analysis of employment effects can be conducted applying a number of different methodologies. The main ones are briefly listed below.

3.1.2.1. Accounting models

Accounting models are based on expert judgment and stakeholder participation. The starting point for such models is the identification of key drivers of change. For the circular economy, these could, for instance, include levels of reuse, refurbishment, remanufacturing, and recycling. Then, future values of these drivers are estimated for different scenarios through expert judgment and stakeholder participation. This allows for a calculation of impacts on costs, jobs and environment and results can be compared across the previously defined scenarios (Organisation for Economic Cooperation and Development, 2015). Green Alliance and WRAP used this methodology in a number of studies to calculate the potential impact of a CE transition on the whole of Europe, UK, Germany, Italy and Poland (Coats and Benton (2016); Morgan and Mitchell (2015a, 2015b); WRAP (2015)). The results of their analyses are summarized in Section 3.3.

3.1.2.2. Input-output modelling

Input-output (IO) analysis identifies the monetary linkages between production sectors in an economy and between production sectors and consumers of output. The IO table provides a better understanding of the nature of production and consumption flows in an economy during a specific period of time, usually a year. By looking more closely at the flows and comparing them over a number of (subsequent) years, policy makers can gain a better knowledge on how production and consumption sectors have changed, and how the different sectors contribute to the economy and employment (UK Energy Research Centre, 2014; VITO, n.d.). For instance, Dubois and Christis (2014) used IO analysis to determine the potential impact on employment of a transition to a more CE (see Section 3.3).

3.1.2.3. Computable General Equilibrium (CGE) analysis

A CGE model is a tool for empirical economic analysis. It is an analytically consistent mathematical representation of an economy and consists of a detailed database of actual economy-wide data. This database captures the interdependencies across all sectors in the economy at a particular point in time, and a set of equations describing model variables.

CGE models simulate the effect of a policy shock or an exogenous change, i.e., a change external to the system. The model results allow a better understanding of how these exogenous changes affects the endogenous variables of the model, i.e., those variables whose values are determined by the interdependencies across the sectors through the equations described in the model. Depending on the research question and type of model, the effects of certain changes in consumption, production, prices, exports, employment and/or the impact on welfare can be estimated (Greenaway et al., 1993; UK Energy Research Centre, 2014).

CGE models are widely used to simulate the economic impacts of energy and environmental policies, and more specifically, the measures put in place to reduce greenhouse gas emissions (Sue Wing, 2009).

3.1.2.4. Macro-econometric models

A macro-econometric model can comprise a wide range of probability models for macro-econometric analysis and estimation to focus on different aspects of policy. (Bårdsen and Nymoén, 2008; UK Energy Research Centre, 2014). A well-known macro-econometric model is the E3ME model, developed by Cambridge Econometrics (Cambridge Econometrics, n.d.). The model was used, for instance, to conduct a macroeconomic analysis of the employment impacts of future EU climate policies, in which the authors calculated that a 40% reduction in GHG emissions (compared to 1990 levels) could lead to an increase in employment of up to 0.7 million jobs in Europe (Pollitt et al., 2015).

3.2. Prelude - technology and automation

In face of increasing technological change, innovation and automation, the question is often asked whether people will lose their jobs to robots and machines.

Technology changes cause job substitution, job creation - for instance the rise of web analyst and big data specialist jobs -, and job transformation, where some tasks in a job are more likely to be automated than others.

According to Cedefop's 2017 European skills and jobs survey, around half of employees have seen changes in the technologies, working methods and practices they use. While, previously,

technology replaced routine, low-skilled manual work, nowadays, innovative cycles are faster and the extent of digitalization and robotization is greater. For instance, self-driving cars could replace, in a not so far future, taxi drivers. Moreover, digital skills can be outdated or employees can be even excluded from the digital economy (e.g. agricultural workers). According to Cedefop, employees in jobs that require digital skills will need continuous training, with groups such as women, older-aged or low-educated workers, and professionals in high-skill intensive groups demanding specific focus. Also, people and technology are complementary. ICT (information and communications technology) skills require complementary skills, such as foundation skills (literacy and numeracy), soft skills (planning and organization), and behavioural skills (communication and teamwork). While technology can perform certain tasks and synthesize data, people will still be needed to decide on which tasks need to be performed and what the meaning of the data is (Cedefop, 2017).

McKinsey & Company (2017) describe the impact of new digital technologies and automation on the labour market as a balancing act between technological unemployment⁴ and the positive economic impacts of job creation and its ability to boost innovation and productivity. They predict that the coming wave of digital automation and artificial intelligence will have a similar impact as previous innovation waves, with positive effects on net employment and value generation through increased productivity. Similar to Cedefop's findings, they predict that some jobs will nevertheless be made obsolete, and more tasks within jobs will change. Therefore, they advise policy makers to make sure the right mechanisms for training and education are developed to ensure a fast and smooth transition to adapt to a different skill structure in the future.

McKinsey & Company base their forecasts on research that focused on nine “digital front-runners” in Northern Europe, i.e., Belgium, Denmark, Estonia, Finland, Ireland, Luxembourg, Netherlands, Norway, and Sweden. These countries were considered front-runners as they are relatively enthusiastic adopters of digital technology, and are ahead of others in the use of robotics, machine learning and AI. They expect that, among these countries, there is limited risk of increasing unemployment as, between 1999 and 2010, a net employment of 80,000 jobs per year was created by digital technology. About 40% of the new jobs created in this period was directly related to digital and ICT technology, while 60% was created thanks to the indirect effects of reinvesting productivity gains in the economy. More than half of the new jobs were high-skilled. Moreover, McKinsey & Company follow Cedefop (2017) in their expectation that new, complementary, skills will be needed and that these will account for nearly half of the work activities by 2030 (compared to 37% in 2017).

3.3. General CE employment effects

There are two main reasons to assume that the transition to a circular economy would have net positive effects on employment.

First of all, in a circular economy linear resource flows are replaced by circular ones. This means that mining and manufacturing are partly replaced by a whole array of other activities, as described in Figure 1. These activities, such as repair, refurbishment and remanufacturing, are more labour-intensive than mining and manufacturing (which are often highly automated). Secondly, in a circular economy, the goods-to-services ratio changes drastically as the product

⁴ Keynes (1933, p. 364) defined technological unemployment as “unemployment due to our discovery of means of economising the use of labour, outrunning the pace at which we can find new uses for labour”.

life of goods is extended and services are becoming more important (e.g. service economy)⁵. This shift could be further expedited by taxing the use of non-renewable resources instead of taxing labour. Moreover, the nature of these new activities implies limited economies of scale in geographical and volume terms, resulting in a higher labour input (Stahel, 1982, 2013; Wijkman and Skånberg, 2015a).

A number of studies have been published describing general employment effects of the transition to a more circular economy. Broadly speaking, these studies can be divided into two main groups, i.e. quantitative studies and qualitative studies. While the former estimate the number of jobs that could potentially be created because of the transition to a more circular economy, the latter make predictions about existing job types that might disappear, new job types that might be created, and changing competences, skills and educational needs.

Quantitative estimates were made by Bastein et al. (2013); Dubois and Christis (2014); Morgan and Mitchell (2015a, 2015b); WRAP (2015); Coats and Benton (2016); and Wijkman and Skånberg (2015a, 2015b). It is important to mention here that these studies all use different methodologies and different assumptions for their calculations. It is therefore impossible to compare the results of these studies with one another.

The Netherlands Organization for Applied Scientific Research (TNO) conducted a study in 2013 to determine the opportunities and threats in the transition to a more circular economy in the Netherlands with 2020 as a time horizon. The methodology used is a combination of accounting models and input-output modelling. They start from a biotic and an abiotic case study and then extrapolate their results to the Dutch economy as a whole. The authors found that an increase in circularity of the Dutch economy could result in about 703 billion euro additional market value and 54,000 jobs (Bastein et al., 2013).

Based on the TNO methodology, Dubois and Christis (2014) conducted a similar exploratory analysis of the economic importance of waste management, recycling and a circular economy in Flanders. Assuming the same time horizon of 2020, they calculated that the transition to a circular economy could potentially generate 2.3 billion euros of added economic value for Flanders, in addition to the creation of 27,000 new jobs (which corresponds to 1% of the Flemish employment).

Then, in 2015, Wrap and Green Alliance conducted an accounting-based study to discover “opportunities to tackle Britain’s labour market challenges through growth in the circular economy” (Morgan and Mitchell, 2015a, 2015b⁶). They defined three scenarios for the potential expansion of the circular economy in Britain, with 2030 as the time horizon. They included circular activities such as reuse, refurbishment, and servitization. Depending on the scenario, they estimate the possible gross job growth between 31,000 and 517,000 jobs, and the net job creation between 10,000 and 102,000 jobs.

Another study conducted by Wrap (WRAP, 2015) on the ‘Economic Growth Potential of More Circular Economies’ uses the same accounting-based methodology and focusses on the impact

⁵ Product life extension of course implies that, ideally, due to lower product demand less materials will be used and less virgin products will be produced. This will impact the manufacturing industries which might experience job losses.

⁶ The publication titled “Opportunities to tackle Britain’s labour market challenges through growth in the circular economy” is a detailed report that provides full information about analysis, calculations and data sources. The publication titled “Employment and the circular economy - Job creation in a more resource efficient Britain” provides a summary of the main findings of the first publication.

on employment of a more circular economy at the European level. The study sets the time horizon at 2030 and focusses on CE job creation by lowering the structural mismatch in high unemployment regions in Europe and by reducing cross-country differences in unemployment. The authors calculated that 1.2 million jobs could potentially be created Europe-wide, with a reduction in unemployment by around 250,000, assuming a scenario equal to the current development of the circular economy; and 3 million jobs, with a reduction in unemployment by around 520,000, assuming transformational expansion of the circular economy. For Belgium, they estimated the possible gross job growth between 5,000 (current development of the circular economy) and 41,000 (transformational expansion of the circular economy), depending on the scenario.

Similarly, in the same year, Green Alliance carried out an analysis looking at “unemployment and the circular economy”, identifying opportunities in Italy, Poland and Germany (Coats and Benton, 2015). Using the same methodology as the above-mentioned studies by Morgan and Mitchell (2015a, 2015b); and WRAP (2015), the authors calculated that, in the most ambitious scenario (transformational expansion), a total of 199,000; 124,000 and 287,000 net jobs could be created in Italy, Poland and Germany respectively, by 2030. Moreover, the authors found that the transition to a circular economy would look different in every country, depending on the opportunities that are present and differ in each of these countries.

Additionally, Wijkman and Skånberg (2015a) investigated, in their study for the Club of Rome, the societal benefits in terms of employment of a significant increase in resource efficiency for a number of European countries for a number of scenarios, using the input-output methodology. They found that, by enhancing energy efficiency, increasing the share of renewable energy and increasing material efficiency at the same time, more than 75,000 additional jobs could be created in Finland, 100,000 in Sweden, 200,000 in the Netherlands, 400,000 in Spain and 500,000 in France. In a follow-up study using the same methodology but focusing on Czech Republic and Poland (Wijkman and Skånberg, 2015b), the authors found that an additional 150,000 jobs could be created in the Czech Republic, while the number for Poland would depend on the development of its agricultural sector.

Qualitative estimates were made by Ellen MacArthur Foundation et al. (2015), Morgan and Mitchell (2015a, 2015b), Coats and Benton (2016), and Bachus et al. (2016) amongst others.

The Ellen MacArthur Foundation, in collaboration with McKinsey and SUN (2015), summarizes a number of employment effects of the transition to a more circular economy. Direct effects are expected in three sectors:

- *waste and recycling sector*: job creation because of increased recycling, reverse logistics and secondary markets,
- *raw materials sector*: less demand for virgin materials, resulting in job losses, some of which outside the EU, and
- *manufacturing sector*: job creation because of upgrade, repair, and remanufacturing activities which are labour-intensive.

They also identify indirect effects in the raw materials and manufacturing sector where jobs might be lost due to decreased demand because of increased prices (raw materials) and because of decreased demand for new products (manufacturing). There might however be differences between sectors and companies.

Finally, they point out the induced effects of increased consumption in all sectors driven by lower prices and new jobs created because of eco-innovation and investments from the CE transition.

Morgan and Mitchell (2015a, 2015b) also discuss the employment effects of the transition to a more circular economy, focussing on changes in skills requirements and geographical location of CE activities. With overall net employment expected to increase, they state it is important to create an understanding about where these increases could occur. They make the distinction between employee skill level on the one hand and CE activities on the other. An overview regarding potential skill needs can be found in Table 1 while Table 2 provides an overview of the potential geographical dispersion of these circular jobs (Morgan and Mitchell, 2015b, 2015a).

Table 1. Potential skill needs by circular economy activity.

Activity	Low-skilled	Medium-skilled	High-skilled
Upcycling	****	****	*
Downcycling	****	**	*
Servitization	***	***	***
Remanufacturing	**	*****	**
Reuse	****	**	*
Biorefining	*	****	*****

Scale from 1* = low to 5* = high

Source: Morgan and Mitchell, 2015a

Table 1 shows that different circular activities indeed have different requirements when it comes to skill level. While recycling (both closed loop or upcycling, and open loop or downcycling) and reuse require a relatively high ratio of low-skilled employees, remanufacturing and biorefining require a relatively high ratio of skilled (medium-skilled) and professional (high-skilled) employees. More specifically, low-skilled employment is used for collecting, handling and processing materials for recycling while higher-skilled employment is needed for technical sorting systems and logistics. New job opportunities in the reuse sector are expected mainly in local and regional reuse and repair centres, with job profiles requiring low to medium-skilled workers. Then, because of less standardization in remanufacturing, jobs in this sector require substantial training needs and, hence, skilled employees. Moreover, because of the need for knowledge of chemistry and engineering, the biorefinery sector is expected to have high skill and educational requirements. Servitization, on the other hand, is an activity that depends on more equal ratios of low-, medium- and high-skilled workers for jobs in customer support and sales, engineering and servicing, and IT and leadership roles respectively (All-Party Parliamentary Sustainable Resource Group, 2014; Beck, 2001; Ecotec, 2002; European Environment Agency, 2011; ILO, 2011; Morgan and Mitchell, 2015a).

Table 2. Potential geographical dispersion of jobs by circular economy activity.

Activity	Job concentration	Areas of concentration	Job displacement risk to activities in other areas
Upcycling	***	Near manufacturing sites, logistics and supply chains	Some risk to existing raw materials extraction
Downcycling	**	Near feedstock and markets, close to major ports	Some risk to existing raw materials extraction
Servitization	***	Head office jobs may be in capital cities; back office and servicing jobs may go abroad	Reduced demand for new products leads to risk to (largely overseas) manufacturing
Remanufacturing	****	Near manufacturing sites, transport hubs and population centres, with some overseas plants	Reduced demand for new products leads to risk to (largely overseas) manufacturing
Reuse	*	Dispersed throughout the country	Reduced demand for new products leads to risk to (largely overseas) manufacturing
Biorefining	***	Near major ports, consuming industries, manufacturing sites, population centres and sources of domestic feedstock	Little risk of significant job displacement

Scale from 1* = low to 5* = high

Source: Morgan and Mitchell (2015a)

Table 2 indicates that CE activities can be quite dispersed geographically and that job concentration follows the geographical concentration. The least concentrated activity is reuse, which is dispersed throughout the country. This means that jobs in the reuse sector will also be spread out, most of them in the reuse centres in cities. As reuse reduces the need for new products, it is likely jobs will go lost in overseas manufacturing companies. Then, downcycling activities are also quite dispersed as collection hubs can be located anywhere in the country. For instance, most municipalities in Flanders have their own recycling park, indicating that jobs in these parks are equally scattered. Moreover, there are advantages to being close to markets and, as some recycling activities take place abroad, there are advantages to being close to ports. Upcycling is geographically more concentrated than downcycling, mostly near manufacturing sites and logistics and supply chains as remanufacturers and reprocessors can form new partnerships near to manufacturing sites. Then, new servitization jobs are more likely to be created where people live and, as population densities are the highest in cities, that is where most new jobs will be found. There will probably be a head office in the (capital) city, with the

possibility of back offices and servicing activities (other than the local delivery of services) abroad. Since servitization reduces the need for new products, owned by the consumer, an increase in servitization activities might negatively impact (overseas) manufacturing. Biorefineries are mostly well distributed geographically, with possible concentration close to ports, consuming industries (f.i., the steel-consuming industry), manufacturing sites, urban population centres and sources of domestic feedstock. Finally, remanufacturing activities are geographically concentrated, near manufacturing sites, transport hubs and population centres, and, while there might be some displacement to overseas remanufacturing plants, this might disturb overseas manufacturing plants due to a reduced demand for newly manufactured products (Coats and Benton, 2016, 2015, Morgan and Mitchell, 2015b, 2015a).

Coats and Benton (2016) state that, based on an analysis of the UK Labour Force Survey, existing circular economy jobs are better than other UK jobs because of less underemployment⁷, higher job satisfaction and longer tenure, meaning that workers will stay with the same employer for a longer time period.

In 2016, Bachus et al. (2016) performed an exploratory qualitative analysis about which existing jobs would change, which new jobs would be created and which changes would occur in job content and competences. The analysis was conducted for four case studies. The authors concluded that there will be an increasing need for knowledge and skills because of vertical integration in value chains. Moreover, a critical role is reserved for managers and their knowledge and skills, as they will be the ones steering the CE transition in their companies. In addition, the first post-consumer phase will gain importance, resulting in an increase in jobs related to activities in this phase, such as reuse and refurbishment. Finally, many job impacts will not be limited to only one phase in the value chain. As vertical integration will become more pronounced, job activities will be integrated across the value chain. New job types were also identified, such as material scout, recycling scout, information manager and environmental steward.

It is important to keep in mind that new and emerging occupations tend to require higher-level qualifications as compared to changes in existing occupations. These changes in existing jobs occur more often at the low and medium skill levels (ILO, 2011).

However, Tamma and Hervey (2018), in an article for Politico, state that the promise of all these new jobs might be overblown. According to estimates, 75% of European circular jobs can be found in the repair and maintenance sector (Weghmann, n.d.). Most growth is expected in the waste and recycling industries but the jobs that are created in these sectors are not always the best. Employment conditions in the circular economy are a highly under-researched topic, and existing research comes to optimistic conclusions (f.i. Coats and Benton, 2016). However, pioneering research on the working conditions in the material recovery facilities for municipal solid waste in Belgium and the UK showed that “it is dirty, often demeaning, physically demanding and in some cases, dangerous work⁸; added to which it is extremely lowly paid” (Gregson et al., 2016, p. 543). The same study by Gregson et al. (2016) also suggests that workers at the material recovery facility cabin process are mostly migrants and that the work is highly gendered, with patterns depending on the type of goods and materials being recovered.

⁷ This study defines underemployment as workers being classed as employment but unable to work as many hours as they would like to.

⁸ The risk of an accident at work is 2.5 times higher in the waste management sector compared to the average for all other sectors (Eurofound, 2012).

Moreover, there is a significant amount of informal recycling taking place especially in Eastern and Southern Europe but also in Northern European Countries. These informal recyclers make a living by the extraction of discarded items from disposal sites, streets, containers and sometimes directly from generators. They then sell the collected materials to the value chains.

3.4. Innovation and circular design

Before discussing the different “steps” in the circular ladder, we start the overview with a crosscutting theme that influences everything else: circular design. Circular design implies (technological) innovation, which can be expected to impact labour market requirements.

The Porter hypothesis (Porter and van der Linde, 1995) states that strict environmental regulations can induce efficiency and encourage innovations that help improve commercial competitiveness. Moreover, according to the hypothesis, the discovery and introduction of cleaner technologies and environmental improvements are triggered by strict environmental regulation. This is called the “innovation effect” and makes production processes and products more efficient.

Rennings et al. (2004) state that the impact of environmental innovation⁹ on the labour market depends on the area in which the innovation occurs. Using econometric analysis techniques, they found that environmental product and service innovations have a relatively positive impact on the labour market because they create a new demand and are a relatively new phenomenon. End-of-pipe innovations, such as recycling, on the other hand, were found to be less beneficial for employment. The authors presume the reason for this is the fact that, since end-of-pipe innovations are quite mature, innovations taking place nowadays in this field are rather labour-saving investments, increasing the productivity of the technology.

Additionally, in their book on the impact of environmental innovations on employment on the firm level, Rennings and Zwick (2012) identify three driving forces for eco-innovation and their respective impact on employment. First of all, environmental concerns as a driving force do not create any employment effects. Secondly, when cost reductions drive innovations, employment tends to decrease. Thirdly, when innovation is motivated by market share considerations, employment trends can go both ways.

3.5. Reduce

The “reduce” step in the circularity ladder consists of the activities of refuse, dematerialise, repair and maintenance. No specific literature has been found on the employment impacts of these reduction activities. Nevertheless, we can assume that refusal and dematerialization activities will have a negative employment impact on the manufacturing industry (as mentioned amongst others by (Ellen MacArthur Foundation et al., 2015; Morgan and Mitchell, 2015a, 2015b), as demand for new products will decrease.

Moreover, as repair and maintenance activities will also reduce demand for new products, they might also have a small impact on employment in the manufacturing industry (Coats and Benton, 2015).

⁹ We assume that innovation in circular design is strongly related to environmental innovation.

3.6. Reuse

Product reuse can create activities in different sectors. The most familiar sectors are those of construction, electronics and textiles. Moreover, reuse is a collection of different activities such as repurpose, refurbish and remanufacture (see Figure 1). In the summary below, no distinction was made between the different activities.

Kibert and Languell (2000) studied the construction sector for the specific case where demolition was replaced by deconstruction in Florida. By means of a case study review, they found deconstruction requires significantly more labour than demolition (every landfill job can be replaced by ten resource recovery jobs) and that it paves the way for employment and training opportunities for relatively unskilled and low-skilled workers. These workers can receive on-the-job training and the basic skills needed for deconstruction can be easily learned and transferred to the construction trades.

A similar conclusion was reached by Gilli and James (2001) who concluded that deconstruction and reuse in the British construction sector can create employment opportunities for the local population as deconstruction is more labour intensive than mechanical demolition.

RREUSE, an organization that represents social enterprise that are active in reuse, repair and recycling, states that reuse can create significant local employment but that currently concrete support policy mechanisms are missing as policy focuses mostly on increasing recycling rates. This lack of support policy mechanisms is inhibiting growth in this sector (RREUSE, 2015). Moreover, the organization calculated that on average 80 jobs could be created for every 1000 ton of collected municipal solid waste. Based on data provided by Flemish reuse centres, they calculated the potential of 200,000 jobs Europe-wide if 1% of the total EU municipal solid waste were to be collected and sorted. Komosie, the umbrella organization of environmental entrepreneurs in the social economy in Flanders, reported that, in 2016, the 30 Flemish reuse centres employed a total of 5426 employees, which is an increase of 2.7% as compared to the previous year (Komosie, 2016).

Specifically for Waste Electrical and Electronic Equipment (WEEE), the same RREUSE study pointed out that 15 jobs and 110 training opportunities could be created for every 1000 ton of WEEE collected and sorted. Europe-wide, this could amount to 55,000 to 93,500 jobs, depending on the assumptions. Additionally, the Illinois Department of Commerce and Economic Opportunity (2006) estimated that for every 1000 ton of electronics, 15 jobs could be created in recycling as compared to around 200 jobs in refurbishment.

Conducting a similar exercise for the textile sector, the RREUSE study calculated that around 20 jobs could be created for every 1000 ton of textiles collected and sorted, adding up to 120,000 jobs in Europe.

Then, specifically for remanufacturing, a study conducted by Parker et al. (2015), focusing on nine sectors and using a combination of methodologies¹⁰, calculated that, currently, remanufacturing employs around 190,000 people in the whole of Europe. Furthermore, projections from the study estimate that, by 2030 and depending on the scenario¹¹, a total of

¹⁰ The sectors in question are aerospace, automotive, heavy duty and off-road equipment, electronic and electrical equipment, machinery and medical equipment, furniture, rail (rolling stock) and marine. The methodologies used were on-line survey, direct phoning, use of meta-studies and top-down analysis.

¹¹ The first scenario, in which 450,000 jobs are created, assumes that remanufacturing becomes an important strategy within a wider circular economy plan for the EU. The second scenario, in which 600,000 jobs are created,

450,000 to 600,000 jobs could be created in the whole of Europe. Nevertheless, the All-Party Parliamentary Sustainable Resource Group (2014), in their report on remanufacturing in the UK, warns that, even though an enormous opportunity for job creation in this sector exists, it requires skilled labour and, hence, the associated costs of training a new or existing workforce should not be underestimated.

3.7. Recycle

Similar to reuse, recycling creates more jobs at higher income levels as compared to landfilling or waste incineration, because it is a more labour-intensive process¹². According to the European Environment Agency (2011), job opportunities exist in particular for low-skilled labour, but also for medium and high-skilled labour. Moreover, Fischer et al. (2011) calculated that the recycling industry created 611 jobs per million European inhabitants in 2007, which is an increase of 45% as compared to the year 2000.

This trend of increasing employment opportunities was also mentioned by Ecotec (2002), in their analysis on EU eco-industries. More specifically, they state that the waste recovery and recycling sector offer particularly good prospects for future employment growth. Similar to the need for training in the reuse sector, Ecotec equally predicts a growing need for training in the recycling sector due to the rapid technological changes and growing need for new skills¹³.

Before the findings by RREUSE (2015) who found that increased collection rates of waste would increase job opportunities in the reuse sector, Friends of the Earth (2010) and Hogg et al. (2011) made similar calculations for the recycling sector.

In 2010, Friends of the Earth estimated the potential employment creation the resource management industry could deliver if much higher targets for recycling and reuse were implemented. They found that up to 322,000 direct jobs could be created in Europe (EU-27) by setting a target of 70% for recycling of key materials¹⁴. This target amounts to 115 million ton of glass, paper, plastic, ferrous and non-ferrous metals, wood, textiles and bio-waste. Moreover, because of the direct job creation, an additional 160,900 new indirect jobs and 80,400 induced jobs would be created.

The following year, Hogg et al. (2011) calculated that, depending on a number of assumptions, the introduction of a deposit refund system could lead to a 4,248 to 4,292 increase in full-time equivalent posts in the recycling sector¹⁵. Moreover, they expect that the majority of these new

assumes that remanufacturing becomes a key strategic pillar for the EU, thereby significantly reducing investment and efforts in recycling, recovery and disposal activities.

¹² Specifically, the CIWMB or “California Integrated Waste Management Board” calculated that recycling a tonne of waste will pay USD 101 more in salaries and wages than disposing of it in a landfill (CIWMB, 2003).

¹³ Employment was estimated on the basis of environmental expenditure – broken down by capital and operational expenditure – and assumptions about wage costs, GDP, population, the Consumer Price Index and exchange rates.

¹⁴ Friends of the Earth calculated the direct employment creation using two approaches. The first one is a simple tonnage/job ratio for all municipal waste recycled by projecting past trends in waste not going to landfill or incineration, while the second one is a more disaggregated approach using the jobs per 1000 tonnes of key recyclables in the total waste stream. Indirect and induced employment were calculated by applying employment multipliers for the relevant sector and geographical area. More information can be found in Friends of the Earth (2010).

¹⁵ The main activities requiring additional labour are take back of containers from customers and placing in storage locations; and facilitating pickup of containers from the contracted logistics company. Labour costs related to these additional activities entail labour costs for customer take back via reverse vending machines, labour costs for

jobs would be of a similar skill level as the existing jobs skill levels. Nevertheless, there might be a slight increase in the total number of higher skilled jobs. The geographical location of these jobs could be quite localised in different collection centres, with some regional logistical centres. Reprocessing jobs would be likely be focused near to or at existing reprocessing sites, or new manufacturing plants.

3.8. Sharing economy

Recently, De Coen et al. (2017) conducted an exploratory study with the goal to conceptualize and inventory the Flemish sharing economy. In the study, they also looked at the expected impact on the Flemish labour market and found that this impact manifests itself on three levels. Firstly, there is the level of job dynamics, which is job creation and destruction due to the development of sharing economy. The second level relates to the terms of employment, such as working hours, wages and workplace. The third level has to do with competences, such as the need for digital competences and the manner in which these competences are developed. Based on a literature review, they identified a number of benefits and drawbacks of the sharing economy.

They found that, on the level of job dynamics, the sharing economy could generate employment opportunities for low-skilled workers as well as provide opportunities for entrepreneurship. On the other hand, in the more traditional companies, employment might decrease because of decreasing prices and demand. Moreover, by remotely facilitating the provision of services, jobs in local labour markets could be offshored. Additionally, the increased breakdown of working activities into individual tasks could be promoted, resulting in, on one side, activities that require high-skilled, and, hence, well reimbursed labour, and, on the other side, activities that require low-skilled labour and risk being offshored and automated.

Then, on the level of terms of employment and labour conditions, they identified flexibility and autonomy as a benefit, which could also help people with employment disabilities find jobs¹⁶, as well as the fact that transactions, such as doing chores, can be taken out of the 'grey' zone and become regulated. The drawbacks include a decrease in job security and predictability of income. Additionally, the absence of a clear legal framework and the resulting lack of social protection could, together with decisive role of rating systems and ensuing risk of bad ratings, result in exploitation or discrimination of the service providers. Furthermore, there can be a skewed work-life balance caused by the increased job flexibility.

Finally, on the level of job competences, advantages of the sharing economy encompass the triggering of entrepreneurship and the use of uncertified or informal competences. A possible disadvantage is the lack of training (Berg, 2016; Codagnone et al., 2016b, 2016a; De Coen et al., 2017; De Groen and Maselli, 2016; Degryse, 2016; Drahokoupil and Fabo, 2016; European Commission, 2016b; Huws, 2014; Kane, 2016; Maselli et al., 2016; Organization for Economic Cooperation and Development, 2016; Todolì-Signes, 2017).

manual consumer take back, labour costs for consumer take back from retailers outside of the deposit system, and labour costs for container collection,

¹⁶ As these people cannot predict when they will be fit to work because of their disability, the flexibility that comes with the sharing economy opens up new opportunities to them.

3.9. Performance economy (servitization)

In his book on the Performance Economy, Stahel (2010) writes about the ability of this performance economy to create new jobs. Scientific and technological innovations, i.e. the “knowledge economy”, can create high-skilled jobs in the global market. Then, innovative asset management and new business models in industrialized countries can create manual jobs with a large variety of skills and skill levels. These jobs will mainly be created locally, especially in industrialized countries, because the extended service-life of durable goods can substitute energy and materials for labour. An extension of service-life implies an increase in reuse, repair and remanufacturing, indicating that more skilled workers will be needed to take up these positions. Projections on job creation through the increase in reuse, repair and remanufacturing were already discussed in Section 3.6.

3.10. Overview

Table 3. Literature overview employment in the circular economy.

Source	Geographical coverage	Circular ladder					Sharing economy	Performance economy
		General	Design	Reduce	Reuse	Recycle		
Bachus et al., 2016	Flanders	x						
Bastein et al., 2013	The Netherlands	x						
Coats and Benton, 2015	Italy, Poland and Germany	x		x				
Coats and Benton, 2016	UK	x						
Dubois and Christis, 2014	Flanders, Belgium	x						
Ellen MacArthur Foundation et al., 2015	Europe	x						
Morgan and Mitchell, 2015a	UK	x						
Morgan and Mitchell, 2015b	UK	x						
Wijkman and Skånberg, 2015a	Finland, Sweden, the Netherlands, Spain and France	x						
Wijkman and Skånberg, 2015b	Czech Republic and Poland	x						
WRAP, 2015	UK and EU	x						
Rennings et al., 2004	Germany, UK, Italy, the Netherlands, Switzerland		x					
Rennings and Zwick, 2012	Germany, UK, Italy, the Netherlands, Switzerland		x					
All-Party Parliamentary Sustainable Resource Group, 2014	UK				x			
Gilli and James, 2001	UK				x			
Illinois Department of Commerce and Economic Opportunity, 2006					x			
Kibert and Languell, 2000	Florida, USA				x			
Parker et al., 2015	Europe				x			
RREUSE, 2015					x			
Ecotec, 2002	Europe					x		
European Environment Agency, 2011	Europe					x		
Fischer et al., 2011	Europe					x		
Friends of the Earth, 2010	Europe and UK					x		
Hogg et al., 2011	UK					x		
Berg, 2016	Europe						x	
Codagnone et al., 2016a	Europe						x	
Codagnone et al., 2016b	Europe						x	
De Coen et al., 2017	Flanders						x	
De Groen and Maselli, 2016							x	
Degryse, 2016							x	
Drahokoupil and Fabo, 2016	Europe						x	
European Commission, 2016b	Europe						x	
Huws, 2014							x	
Kane, 2016							x	
Maselli et al., 2016							x	
OECD, 2016							x	
Todoli-Signes, 2017							x	
W.R. Stahel, 2010								x

4. The labour market in Flanders

To understand the potential impact of the transition to a more circular economy on employment in Flanders, it is important to understand current job market dynamics. We therefore analyse the Flemish labour market in its current form concerning a number of dynamics. We start from a general analysis, focusing on the characteristics of the Flemish unemployed, and then zoom in on the sectors that are contained within the circular economy. Where data is available, we focus specifically on low-skilled labour. This section differs from the previous section, Section 3, in that, in the previous section we discussed the effects on employment when the transition to a circular economy has taken place, while, in this section, we discuss the current characteristics of the Flemish labour market, at the take-off stage for the transition to a circular economy.

4.1. Characteristics of the unemployed in Flanders

In this section, we focus on the supply side of the Flemish labour market. We collect statistics regarding unemployment rates and non-working job seekers from Arvastat¹⁷. Analysing these statistics allows us to get an idea about the profile of the unemployed, and, hence, about possible opportunities for the circular economy. As the results will show, low-skilled workers are a large and important target group of non-working job seekers.

Figure 2 represents the evolution of the unemployment rate¹⁸ (in %) per Flemish province, recorded in January of each year from 2000 to 2017. The transparent grey bars represent the Flemish average.

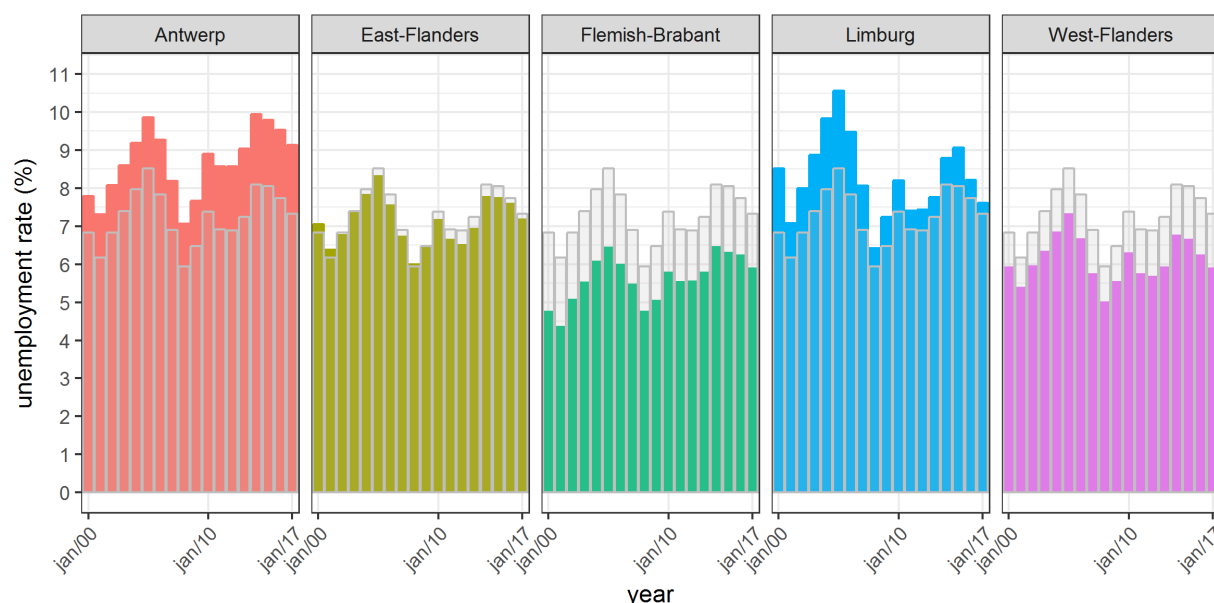


Figure 2. Unemployment rate (in %) per province (red bars) recorded in January of each year from 2000 to 2014. The grey bars represent the Flemish average.

Source: Arvastat

¹⁷ [Arvastat](#) is a public database developed by VDAB where one can consult statistics on unemployment and vacancies in a fast and simple manner.

¹⁸ The unemployment rate is the share of job seekers in the active population.

The graph clearly shows that there is substantial variation in unemployment across the Flemish provinces. It remains above average in the provinces of Antwerp and Limburg, while it is below average in the provinces of Flemish-Brabant and West-Flanders. It is more or less equal to the provincial average in East-Flanders.

The unemployment rate only captures people who were not working in a given period, but were available and actively seeking work. Hence, it does not include the inactive people who are neither working nor seeking jobs.

In what follows, we have a closer look at the characteristics of the Flemish unemployed. As the likelihood of being unemployed is strongly related to skill level, geographical location, period of unemployment, age, origin and occupational disability, it is important to understand to which extent these factors contribute to Flemish unemployment.

Figure 3 represents the number of non-working job seekers¹⁹ in Flanders per skill level, recorded in January of each year from 2000 to 2017.

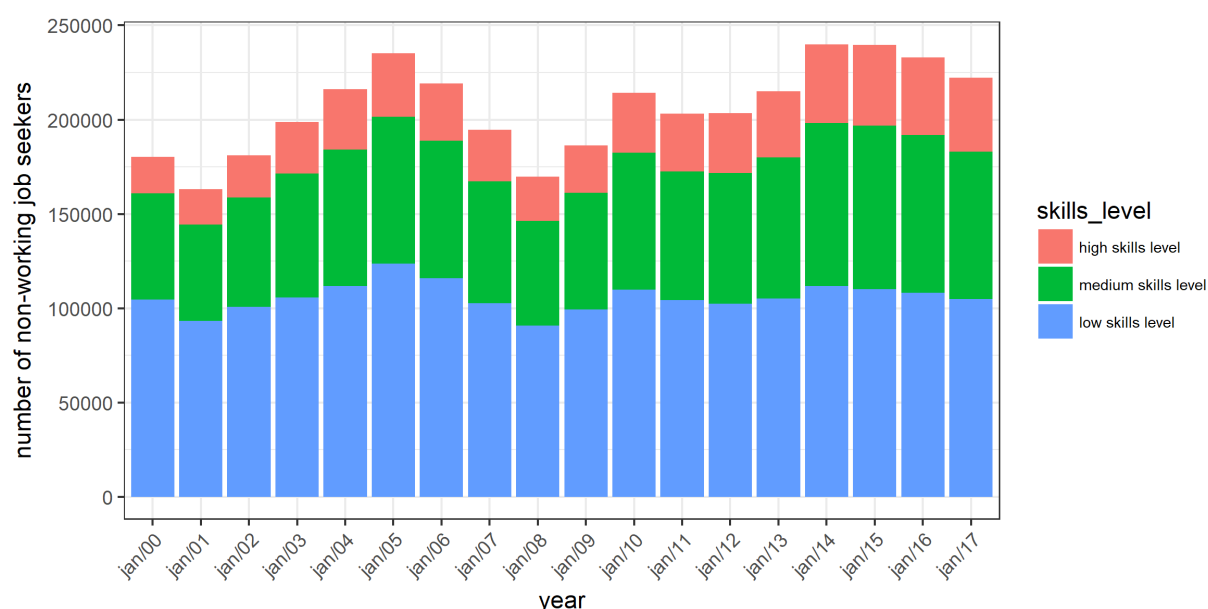


Figure 3. Number of non-working job seekers in Flanders per skill level, recorded in January of each year from 2000 to 2017.

Source: Arvastat

The graph indicates that the highest number of job seekers can be found in the low skill level category, followed by the medium skill level and then the high skill level.

Then, Figure 4 shows the same group of non-working job seekers according to geographical location (province-wise) and skill level, as percentage of the total amount of non-working job seekers. The transparent grey bars indicate the regional average ratios.

¹⁹ More information on what constitutes a non-working job seeker can be found [here](#).

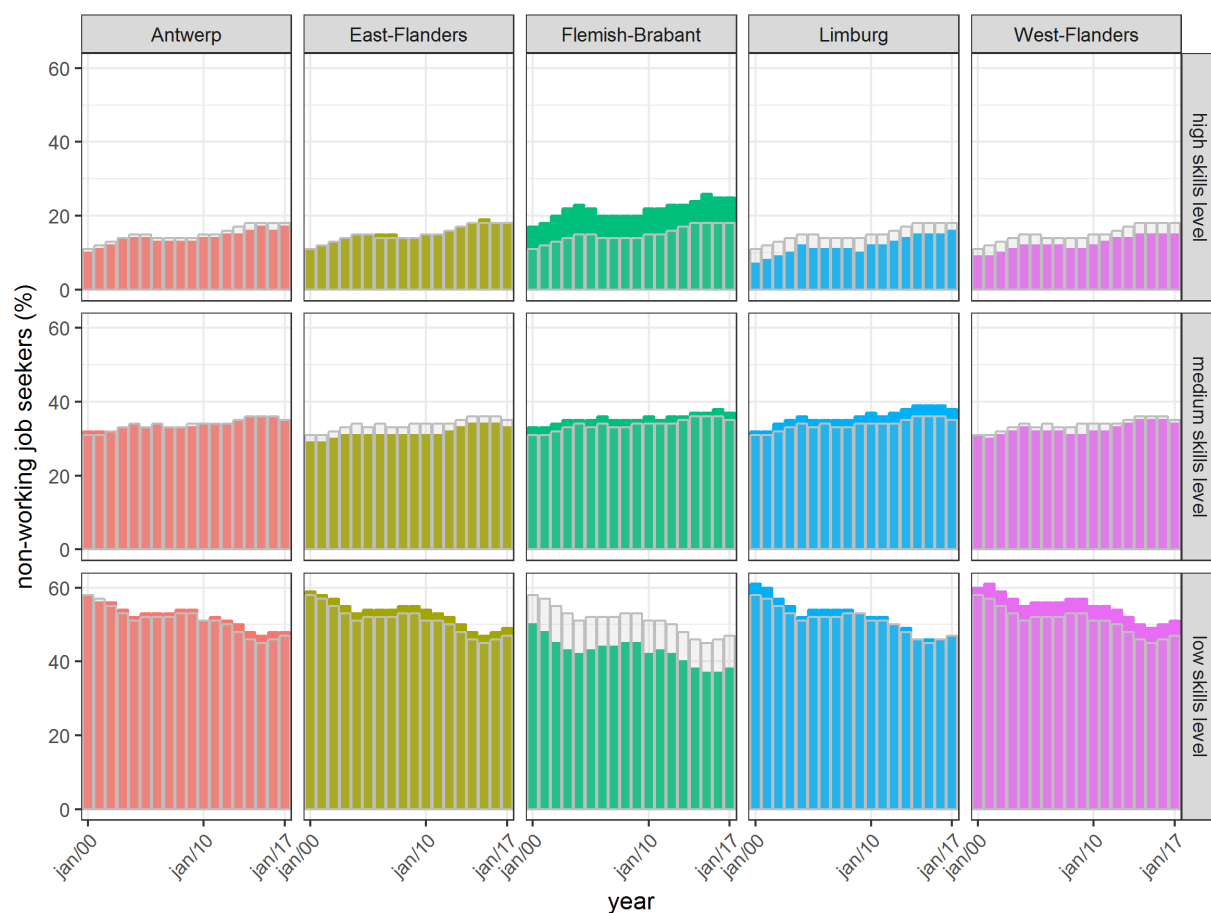


Figure 4. Number and ratio of non-working job seekers in Flanders per province and skill level, recorded in January of each year from 2000 to 2017. The grey bars represent the Flemish average.

Source: Arvastat

The figure indicates that all provinces, with the exception of Flemish-Brabant, display the same ratio of job seekers per skill level.

Figure 5 shows, per skill level, the percentage of non-working job seekers in relation to the period of unemployment.

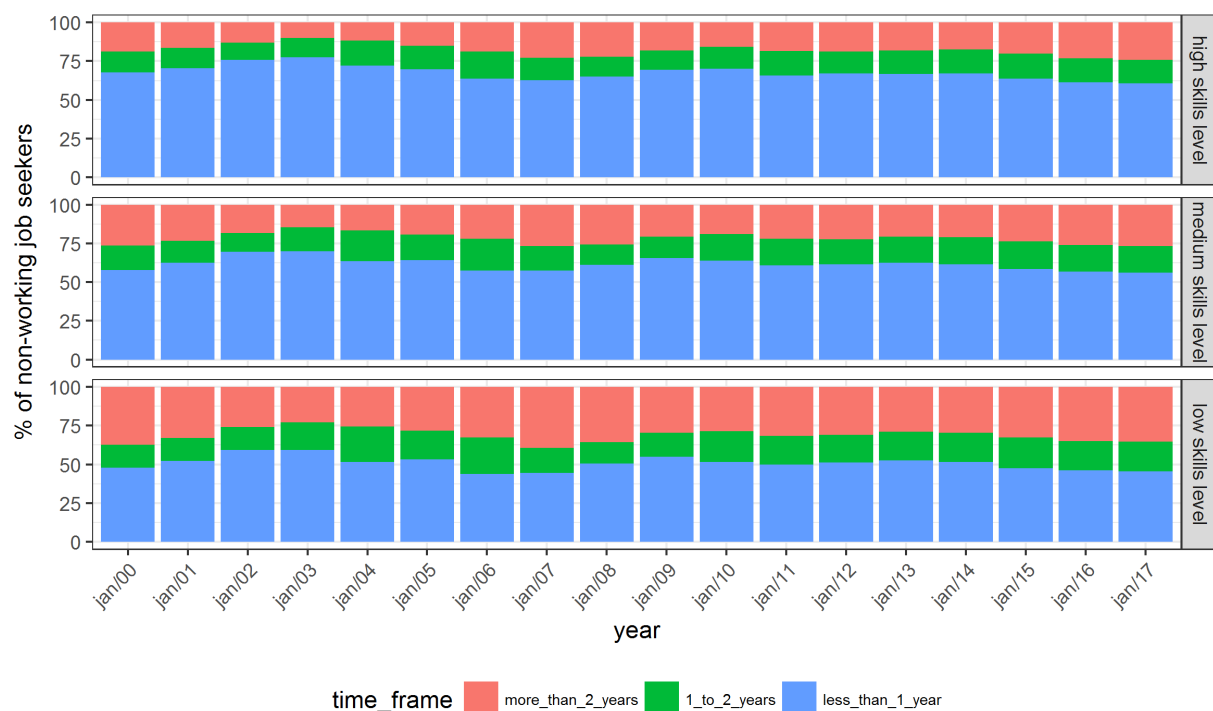


Figure 5. Percentage of non-working job seekers in Flanders per skill level and period of unemployment, recorded in January of each year from 2000 to 2017.

Source: Arvastat

People who have been out of work for a long time (more than 2 years) are often considered the least likely to benefit from any general pick-up in the economy and to have lower re-employment possibilities (Morgan and Mitchell, 2015a). The figure indicates that mostly low-skilled job seekers suffer from long-term unemployment (around 35%).

Figure 6 provides information about the age structure of the job seekers and the period of unemployment.

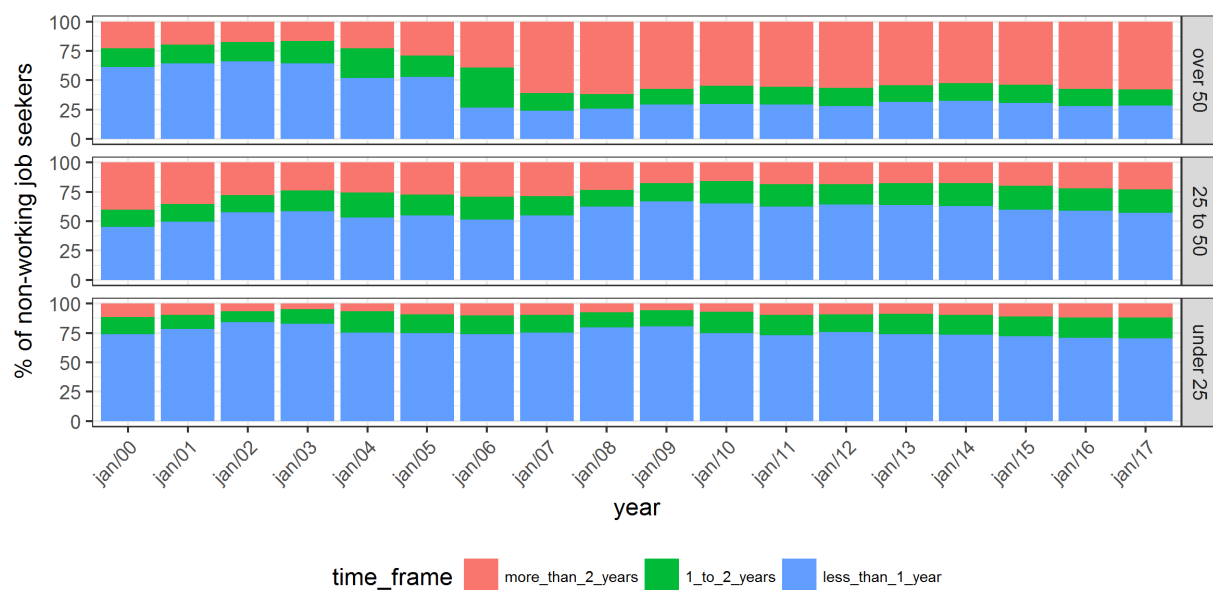


Figure 6. Percentage of non-working job seekers in Flanders per age category and period of unemployment, recorded in January of each year from 2000 to 2017.

Source: Arvastat

The likelihood of being unemployed is strongly related to age. As the job seekers' age increases, the chance of being unemployed for a longer period increases as well. The figure indicates that more than half of the job seekers of age 50 and over have been unemployed for more than 2 years.

Figure 7 shows the skill level of non-working job seekers according to their origin, as an average percentage for the year 2016.

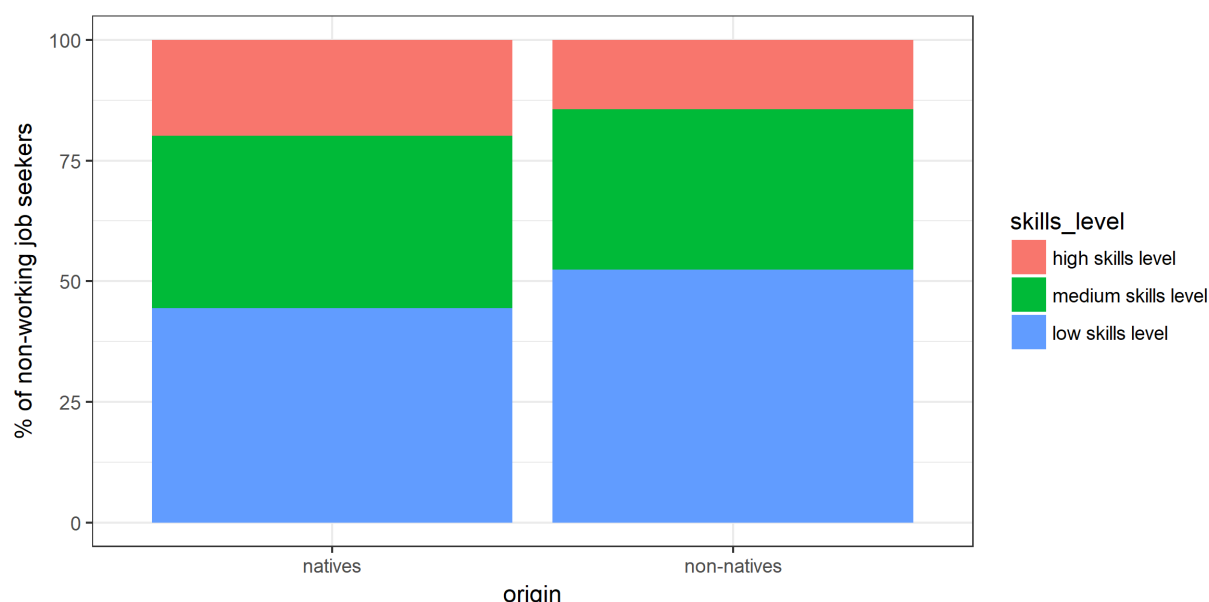


Figure 7. Percentage of non-working job seekers in Flanders per origin and skill level, average for 2016.

Source: Arvastat

Non-native job seekers are officially defined by VDAB as job seekers who have a current or previous nationality from outside the European Economic Area²⁰. A downside of this definition is that immigrants of the second and third generation, who acquire Belgian nationality at birth, cannot be traced. As a result, the actual number of non-native job seekers is underestimated and cannot be traced by VDAB. This is important because non-natives are less present in the labour market, have less work and are subject to a higher unemployment rate (Studiedienst VDAB, 2012).

Moreover, the figure indicates that non-natives are exposed to higher levels of low skills as compared to native job seekers. According to VDAB (Studiedienst VDAB, 2012), there are a number of reasons. First of all, there are often fewer educational possibilities in the country of origin because the educational provision – and certainly the higher educational provision – is smaller and access to education is more difficult. Moreover, there is no compulsory schooling in many developing countries and the accessibility of educational facilities is more difficult. In addition, children often have to take care of the family income at a young age by carrying out wage labour, hence reducing chances of going to school.

²⁰ The VDAB definition of non-native job seekers is based on the definition of the VESOC (the Flemish Economic and Social Consultative Committee) which states that someone is non-native if he/she does not have a nationality from one of the countries of the European Economic Area or if at least one parent or at least two grandparents have a nationality from outside the European Economic Area. Although this definition departs from the nationality concept, due to the provisions relating to the nationality of the parents and grandparents, the origin is, to a certain extent, integrated into the definition.

Another vulnerable group in the labour market is the group of people with an occupational disability. An occupational disability is "any long-term and important problem of participation in working life due to the interplay between functional disorders of mental, psychological, physical or sensory nature, limitations in carrying out activities and personal and external factors" (Studiedienst VDAB, 2010a)²¹. Figure 8 represents the ratio (in %) of non-working job seekers with an occupational disability to the total amount of job seekers, per skill level, while Figure 9 represents the ratio (in %) of disabled non-working job seekers per skill level to the total amount of disabled non-working job seekers.

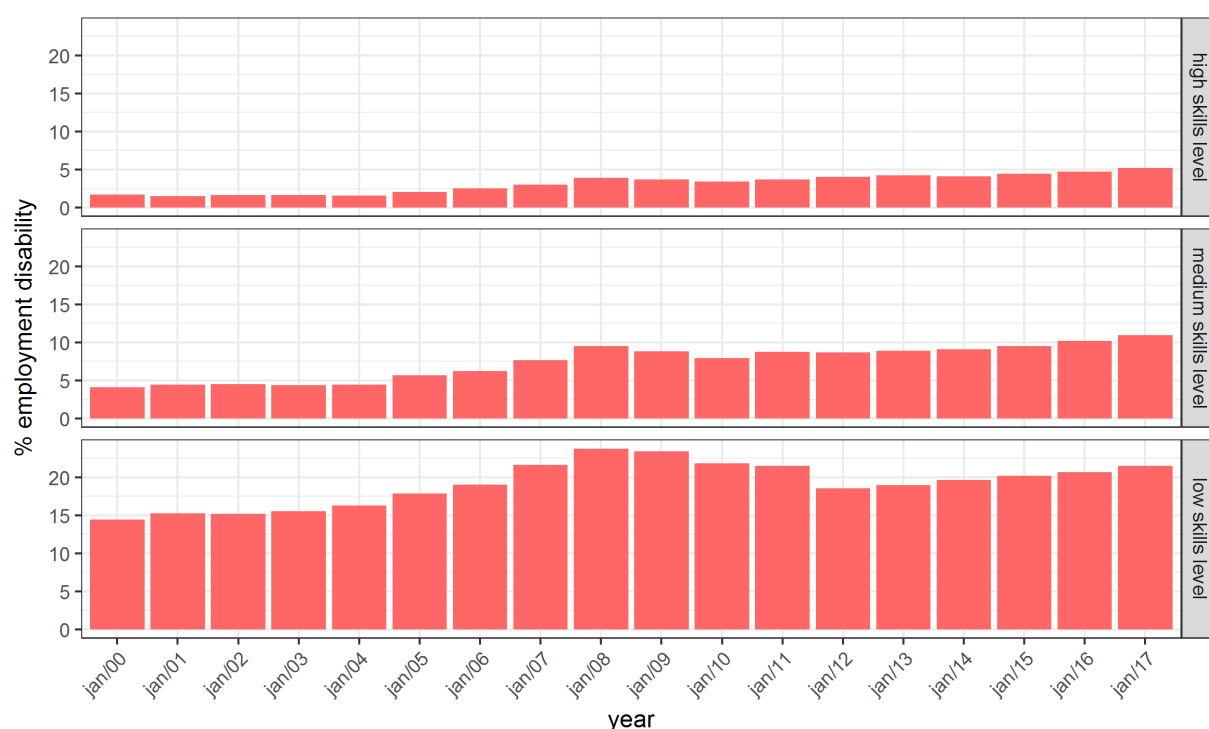


Figure 8. Percentage of disabled non-working job seekers in Flanders per skill level, compared to the total amount of job seekers per skill level, recorded in January of each year from 2000 to 2017.

Source: Arvastat

Overall, Figure 8 indicates a trend of increasing amounts of job seekers with an occupational disability, for all skill levels.

²¹ In order to determine who has an occupational disability, the theoretical definition must be translated into concrete, measurable terms. According to the decision of the Flemish Government (BVR) of 18 July 2008 concerning the professional integration of persons with a disability (Article 3), persons with an indication of occupational disability are: (i) persons with disabilities, recognized by the Flemish Agency for Persons with a Disability (VAPH); (ii) persons who are former pupils of special education and who have at best obtained a certificate or diploma in special education; (iii) persons who, on the basis of their disability, are eligible for an income replacement allowance or integration allowance, provided to persons with disabilities on the basis of the Act of 27 February 1987 concerning allowances for persons with disabilities; (iv) persons who are in possession of a copy of a judicial decision that has become final or of a certificate from a competent federal institution showing a permanent degree of incapacity for work; (v) persons entitled to additional child benefit or persons entitled to an increased child benefit for their child or dependent children as a parent with a disability; (vi) persons receiving an invalidity benefit on the basis of the Royal Decree of 3 July 1996 implementing the Act on compulsory health care insurance and benefits, coordinated on 14 July 1994; and (vii) persons with a certificate from a service recognized by VDAB or doctor.

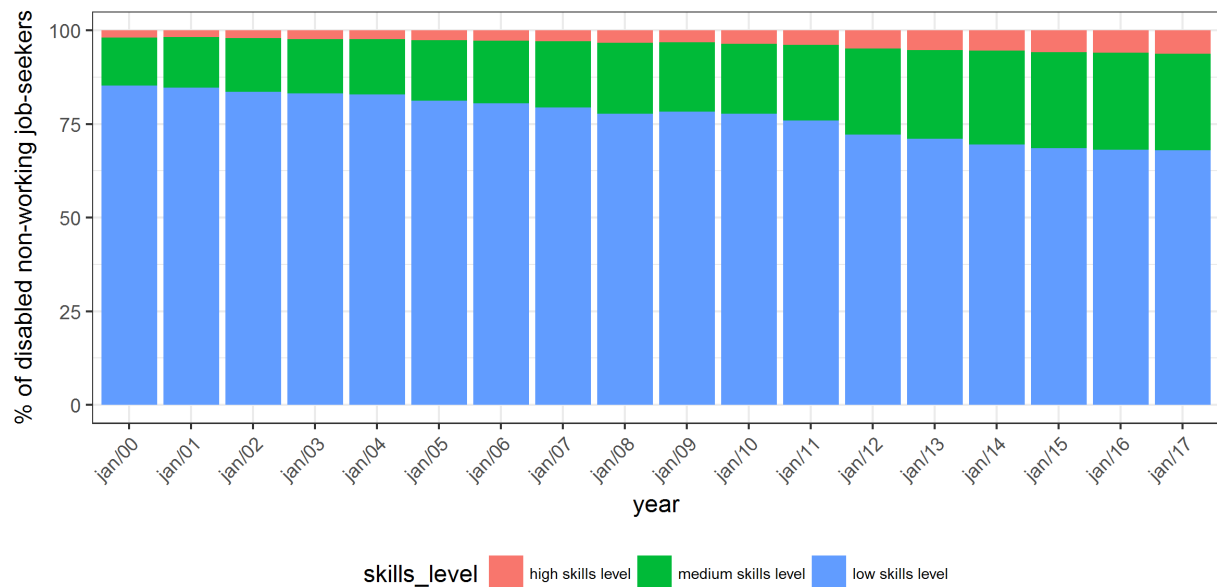


Figure 9. Percentage of disabled non-working job seekers in Flanders per skill level, compared to the total amount of disabled non-working job seekers, recorded in January of each year from 2000 to 2017.
Source: Arvastat

Figure 9 shows that the overall trend of an increase in the ratio of disabled non-working high-skilled job seekers follows the overall trend of an increase in high-skilled people in the labour market. The ratio of highly and medium-skilled disabled non-working job seekers is slowly increasing as compared to the low-skilled job seekers. This could be potentially explained by an increase in burn-outs and depressions in all levels of the labour force.

The numbers and figures presented above illustrate the importance of low-skilled workers and the vulnerability they face on the labour market; percentages of low-skilled job seekers are higher than those of medium and high-skilled job seekers. Moreover, not only low-skilled workers are identified as a vulnerable group on the labour market. Next to this group, VDAB (Studiedienst VDAB, 2013) also defines the long-term unemployed, job seekers with an occupational disability, non-native job seekers and older job seekers as vulnerable groups. As the figures above show, there is often a correlation between one or more of these vulnerable groups. For instance, a larger proportion of older job seekers has suffered from long-term unemployment as compared to younger job seekers. An increase in employment put in motion by the transition to a CE could hence create job opportunities for these groups (as well as the non-vulnerable groups, as we will see later on in this report) and reduce overall unemployment.

4.2. CE employment per NACE sector

After looking at the general labour market trends for Flanders, we now zoom in on those sectors that are relevant for the circular economy, not capturing the new sectors that will arise due to the transition to a circular economy. At this exploratory stage, we make use of more general statistics obtained from Eurostat (at the Belgian level) and Steunpunt Werk²² (at the Flemish level). In a further stage, we will perform a more thorough analysis, exploring the characteristics of circular companies and their employees.

²² [Steunpunt Werk](#) is a university knowledge centre that supports and orientates Flemish labour market policy through monitoring, analyses, projections and evaluations. It is also a hub for spreading labour market information.

The quantitative analysis is based on the NACE rev. 2 classification, which is the “statistical classification of economic activities in the European Community” (Eurostat, 2008, p. 5). This classification provides the framework for collecting and presenting a large range of statistical data according to economic activity in the fields of economic and other statistics and has been used in the European Union since 1970 (Eurostat, 2008).

More specifically, in this first stage we base ourselves on the NACE sectors selected by Dubois & Christis (2014) in their exploratory analysis of the economic interest of waste management, recycling and the circular economy for Flanders. In the more thorough analysis at a later stage, we will use the outcome of two SuMMA expert workshops²³ to define “the circular economy” based on NACE sectors.

The NACE sectors we will look at in this report are presented in Table 4 below.

Table 4. Overview of the relevant NACE code divisions and their description.

NACE section	NACE code	Description
E	37	Sewerage
E	38	Waste collection, treatment and disposal activities; materials recovery
E	39	Remediation activities and other waste management services
G	46.77 ²⁴	Wholesale of waste and scrap

Figure 10 to Figure 14 below provide some useful information for the above-mentioned NACE sectors regarding size (number of enterprises and employees), different types of cost related to employment and gender, age and occupation ratios of the employees.

The data provided by Eurostat (Figure 10, Figure 11 and Figure 14) are only available at country level, hence these figures represent data for Belgium and not for Flanders. Figure 12 and Figure 13 are based on Flemish data. The meaning of the abbreviations used in the figures can be found in Table 5 below.

Table 5. Overview of the abbreviations used in Figure 10 and Figure 11.

Indicator	Abbreviation
average personnel costs (personnel costs per employee) (thousand €)	avg_pers_cost(K€)
number of employees	no_employees
number of enterprises	no_enterprises
number of persons employed per enterprise	no_empl_enterprise
personnel costs (million €)	pers_costs(MM€)

Personnel costs are made up of wages, salaries and employers' social security costs. They include taxes and employees' social security contributions retained by the employer, as well as the employer's compulsory and voluntary social contributions. *Average personnel costs* (or unit

²³ The first workshop took place on 7 March 2018 to brainstorm on the definition of “the circular economy” based on the NACE terminology. The second workshop took place on 27 March 2018 to exchange ideas on the definition of “the circular economy” between experts of the Circular Economy Policy Research Centre and to develop possible future scenarios for a “circular economy”.

²⁴ As not all the general data is available at this more detailed NACE level, we will use the data for NACE code 46 (“Wholesale trade, except of motor vehicles and motorcycles”) when data for NACE code 46.77 is unavailable, keeping in mind that these numbers are overrated as we are only interested in a small portion of the sector.

labour costs) equal personnel costs divided by the number of employees (persons who are paid and have an employment contract).

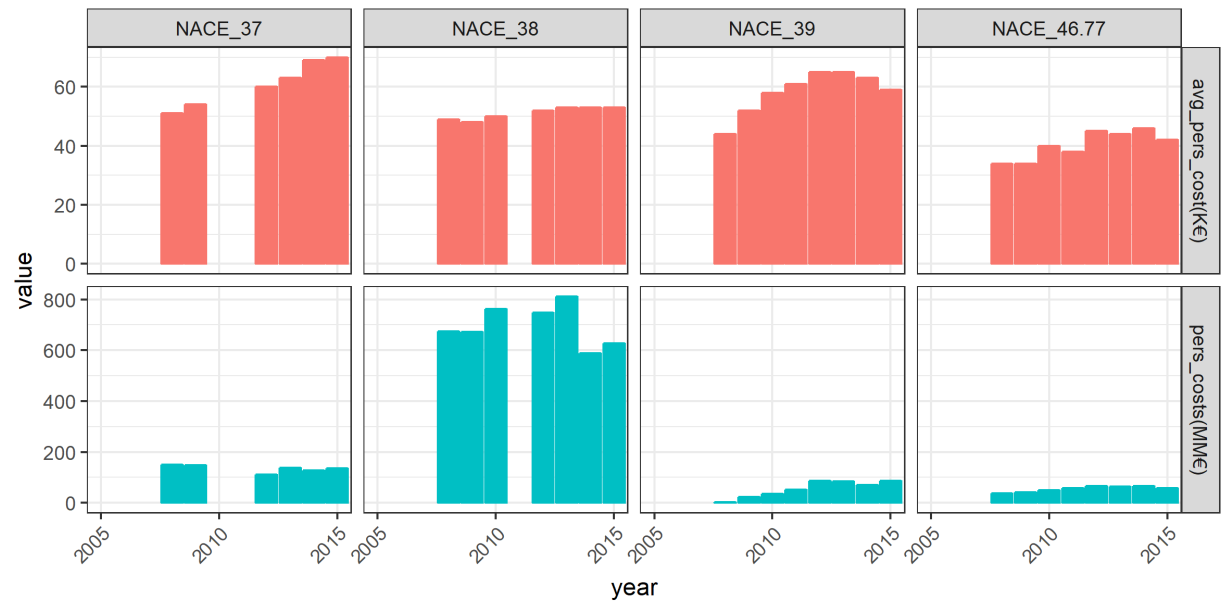


Figure 10. Personnel cost overview for relevant CE NACE sectors for Belgium. Empty bars represent missing data.
Source: Eurostat

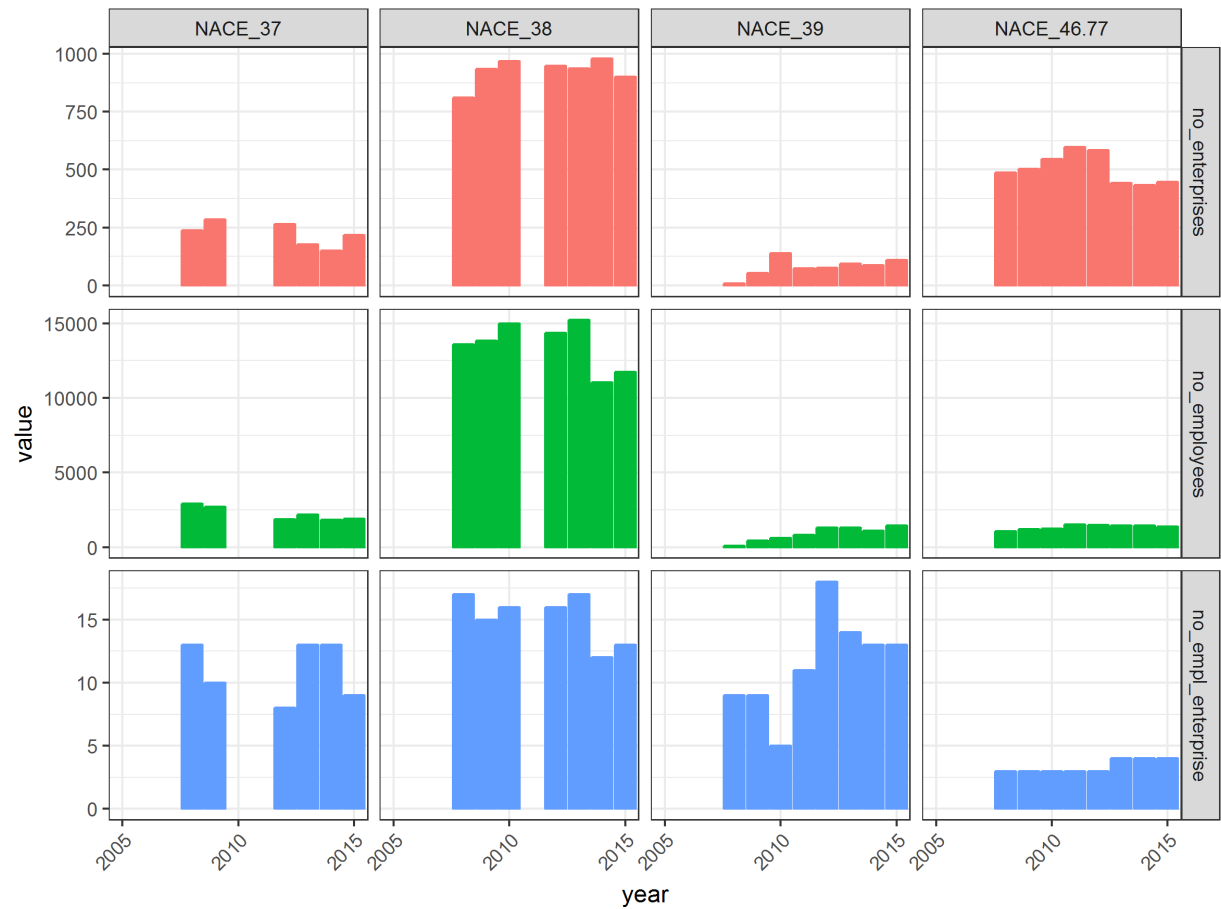


Figure 11. Overview of number of enterprises and employees for the relevant CE NACE sectors for Belgium. Empty bars represent missing data.
Source: Eurostat

Figure 10 shows personnel costs are the highest in NACE_38. This is logical seeing this sector also contains the highest number of enterprises and employees (see Figure 11). The average personnel costs are the highest for sector 37 and the lowest for sector 46.77. The difference in average personnel costs could partly be explained by the distribution of occupations (see Figure 14). There is a higher ratio of low-wage occupations in sector G – of which sector 46.77 is part – as compared to sector E – of which sectors 37 to 39 are part. The sectors involved in waste management (37 to 39) are all about the same average size, while sector 46.77 is a sector comprised of rather small companies.

Figure 12 presents the gender ratio of employees for the relevant NACE sectors in Flanders. Data in regard to gender composition is only available for sector 46, which consists of others subsectors beside besides sector 46.77.

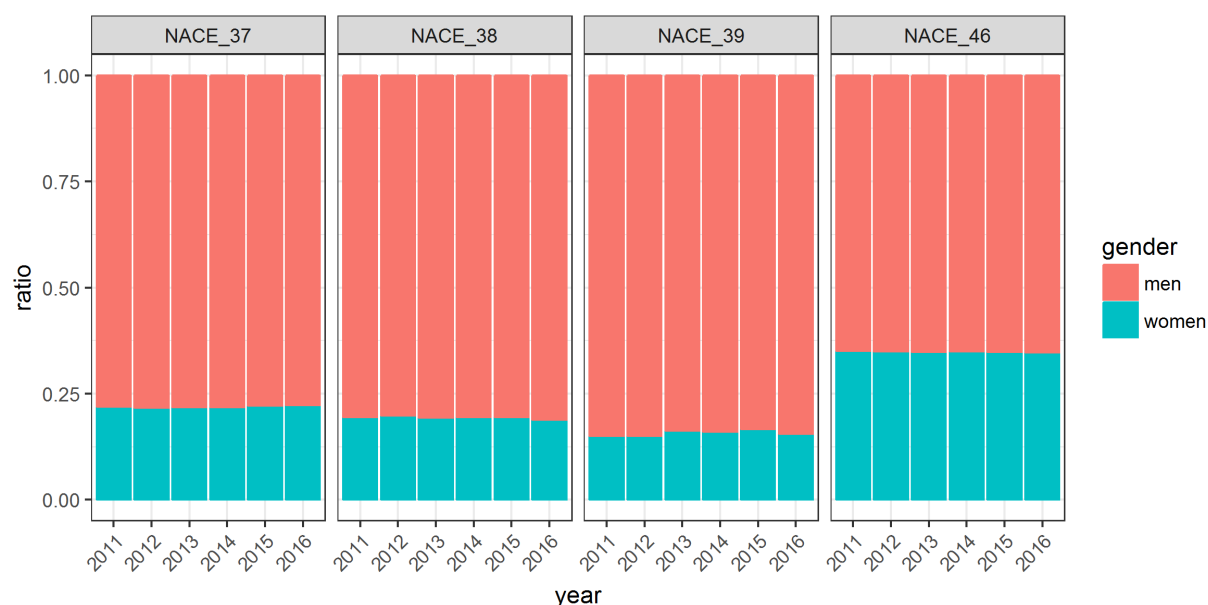


Figure 12. Gender ratio for the relevant CE NACE sectors for Flanders.

Source: RSZ, Steunpunt Werk

The four selected sectors are clearly masculine sectors where less than 25% and around 40% of the workforce consists of women for the waste (NACE sectors 37 to 39) and wholesale and retail trade (NACE sector 46) sectors respectively.

Figure 13 provides an overview of the age distribution the selected sectors. Please note that data in regard to age composition is only available for sector 46, which consists of other subsectors beside besides sector 46.77.

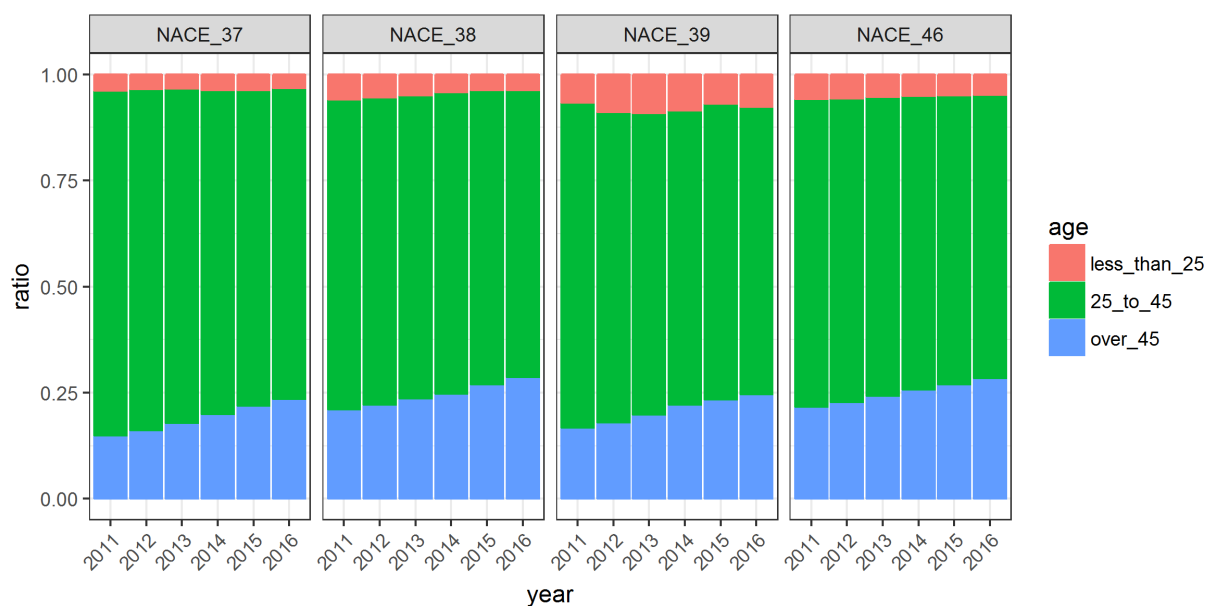


Figure 13. Age ratio for the relevant CE NACE sectors for Flanders.

Source: RSZ, Steunpunt Werk

From Figure 13, we can derive that the employees in these sectors are mostly between 25 and 45 years of age. However, judging from the increase in “over 45 year old” employees, we can say that, over the years, the workforce has aged significantly.

Next, we look into the different types of occupations present in these two sectors. The reason to do this is that the type of job can help to understand whether jobs are “net” gains with respect to unemployment (Organisation for Economic Cooperation and Development, 2015). For instance, additional jobs for high-skilled workers will not significantly reduce unemployment since their current employment rate is already negligible. In contrast, additional jobs for low-skilled occupations could reduce unemployment since jobs are scarce for this category of job seekers (see Section 4.1).

The classification of occupations is based on ISCO-08, the “International Standard Classification of Occupations”, a “tool for organising all jobs in an establishment, an industry or a country into a clearly defined set of groups according to the tasks and duties undertaken in the job” (ILO, n.d.). Definitions for each occupational type can be found in ILO's document on “Definitions of major groups, sub-major groups, minor groups and unit groups (2008). As it is difficult to divide occupation type according to skills requirements, we have divided them based on average wage levels (Morgan and Mitchell, 2015a), i.e. high-wage occupations in blue tones, mid-wage occupations in pink tones and low-wage occupations in green tones. Eurostat defines low-wage earners as “employees who earn two thirds or less of national median gross hourly earnings”. In 2014, in Belgium, 3.8% of employees were low wage earners (Eurostat, n.d.).

Figure 14 presents the Belgian occupation ratio for the two selected CE NACE sectors (NACE E and NACE G) while

Table 6 below explains the abbreviations used in the figure. Please note that data in regard to occupational composition is only available at the aggregated levels of sector E and G. Sectors 37 to 39 and sector 46.77 are a part of sector E and G respectively.

Table 6. Overview of the abbreviations used in Figure 14.

Occupation	Abbreviation
Low wage occupations	
elementary occupations	elem_occup
service and sales workers	serv_sale_work
Mid-wage occupations	
plant and machine operators and assemblers	plant_mach_oper_assem
craft and related trades workers	craft_rel_tr_work
clerical support workers	cler_sup_work
skilled agricultural, forestry and fishery workers	skilled_agr_for_fish
High wage occupations	
technicians and associate professionals	techn_assoc_prof
managers	managers
professionals	professionals

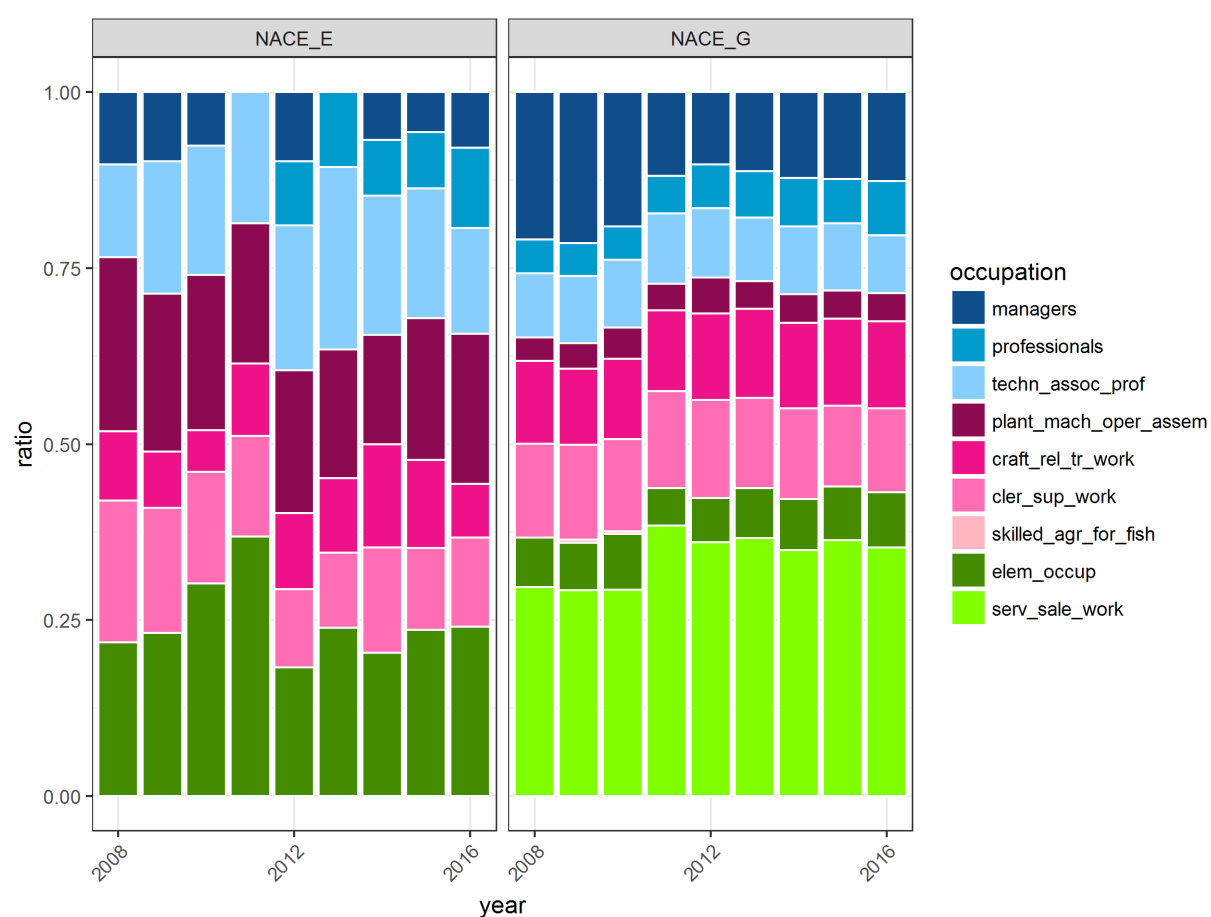


Figure 14. Occupation ratio per NACE sector (as % of people per occupation type) for Belgium in the year 2016. Colour scales indicate high wage (blue), mid-wage (pink) and low wage (green) occupations.

Source: Eurostat

While Morgan and Mitchell (2015a) report a decline in mid-level jobs in Britain, Figure 14 indicates that there has not been such a “hollowing out” for the two selected sectors in Belgium. On the contrary, while the share of mid-wage occupations seems to have remained relatively constant for both sectors from 2008 to 2016, the share of high-wage (low-wage) occupations has increased (decreased) in the waste sector (sector E) and decreased (increased) in the wholesale trade sector (sector G) for that same period.

As previous research has already pointed out, in the transition to a more circular economy the ratio of these occupations types could change, depending on the sector and the emerging needs (see Section 3.3).

4.3. Labour market mismatches

In this section, we look at labour market mismatches, meaning that there are differences between the characteristics of the unemployed and the available jobs. In this review, we specifically look at two different types of mismatches, educational and geographic mismatch. It is, however, important to mention that there are other reasons as to why the distance to the labour market might be large for some people, such as physical, psychological or social issues for instance.

Labour market mismatches lead to unemployment. By creating demand for specific profiles and at different geographical locations (see Section 3.3), a CE could contribute to reducing these mismatches and, hence, unemployment.

At all times, the number of jobs depends on the meeting between supply and demand on the labour market. At given supply and demand levels, when the labour force is perfectly attuned to the functions offered and the available information does not show any gaps, the number of jobs corresponds to the minimum of demand and supply and the labour market functions effectively (Cahuc and Zylberberg, 1996).

In reality, however, the jobs and the workforce are heterogeneous (for example, the required and offered experience, knowledge and competencies differ) and the information never fully circulates. This way, some workers do not find a job, while, at the same time, some companies have vacancies (Zimmer, 2012). This raises questions about the 'match' between the demand for and the supply of labour. The mismatches have various causes, which can be cyclical, frictional or structural.

In times of economic boom, when the demand for labour rises, companies are the ones who experience matching difficulties. When the economy slows down or hits a recession, job seekers are more likely to be confronted with such matching problems. As a result, *cyclical unemployment* rises. *Frictional unemployment*, then, is of a temporary nature as some time is needed to make the supply and demand for labour coincide (even when they are completely in line), in particular because of the imperfect and non-instantaneous transmission of information. Finally, the mismatch between supply and demand on the labour market can also be *structural*, for example because the job seekers' education level does not correspond to the required competences or due to the lack of geographical mobility. Such mismatches on the labour market are, on the one hand, a social problem because of the unemployment or inactivity that results from this and, on the other hand, an economic problem, both for the companies and for the country (through the reduction of the growth potential of the economy).

These different types of unemployment can also influence each other. For example, a low level of education (structural unemployment) can slow down finding a job (frictional unemployment) and cyclical recruitment problems can be aggravated by structural mismatch problems, which can lead to labour hoarding during a period of low economic activity.

4.3.1. Educational mismatch

Zimmer (2012) states that about 80% of the jobs in Belgium requires medium and high-skilled workers, while the available labour reserve consists of 80% of low and medium-skilled job seekers. There is a low share of highly qualified job seekers in the labour supply and, conversely, a large proportion of job seekers who have not completed their secondary studies, while, at the same time, the labour market's demand for this profile type is low.

In Flanders, medium-skilled people take up around 40% of all jobs, while high-skilled workers take up 37% of all jobs. The educational mismatch is caused by the fact that there are more low-skilled jobseekers than employers actually need, and because there are 'too few' high-skilled job seekers.

Besides attained degrees and diplomas, other factors are at play for job seekers regarding their chances of being employed. And although the profile descriptions associated with jobs are expressed in terms of educational levels or study domains, the actual expectations of companies often go beyond these criteria, which are usually intended to make a first selection of possible candidates. The analysis of the bottleneck jobs ²⁵ (the so-called "knelpuntvacatures"), carried out each year by the regional public employment services such as VDAB, draws attention to the recruitment problems that employers encounter. The rate of filling bottleneck job vacancies is lower than for other jobs and it takes more time to fill those vacancies. Employers find it difficult to recruit candidates because of scarcity on the labour market and because of difficult working conditions, qualitative aspects (required degrees, necessary experience, and languages to be mastered) or lack of mobility. These bottleneck jobs are present in different domains and do not exclusively concern skilled jobs. Table 7 provides an overview of the number of job vacancies received by VDAB and the number of bottleneck vacancies per occupation type for the year 2015.

The list in Table 7 confirms the shortage of technical profiles. Because too few young people opt for a technical education and because of the growing replacement demand because of the aging population, the problem is only getting more pronounced. As some actions in the CE require more technical profiles (see Section 3.3), potential job shortages and labour market mismatches might arise as well.

²⁵ VDAB defines bottleneck jobs as professions for which the filling of the vacancies is on average more difficult than for the other professions because of quantitative or qualitative shortages of labour, or because the unfavorable working conditions of the profession make it less attractive to job-seekers. Examples of these unfavorable working conditions are low wages, unhealthy or heavy work, a lot of stress, unfavorable time regulation (weekend work, evening work, part-time work) or the status of self-employed (Studiedienst VDAB, 2010b).

Table 7. Overview of the number of job vacancies received by VDAB and the number of bottleneck vacancies per occupation type for the year 2015 for Flanders.

occupation type	number of received jobs in 2015 NEC	number of bottleneck vacancies	occupation type	number of received jobs in 2015 NEC	number of bottleneck vacancies
Administrative logistics staff	558	197	Managing ICT staff	761	369
Bank staff	13	0	Department managers	316	95
Operators of metallurgical machines	534	245	Teaching instruction staff	60	29
Company advisors	756	321	Mechanics for vehicles	1027	411
Administrative ICT staff	885	352	Land surveyor	103	44
Practitioners of crafts	201	82	Electrotechnical installers and technicians	625	199
Train conductors and attending staff	43	0	Mechanics in metal construction	175	82
Drivers in road transport	3335	1286	Maintenance electricians	808	406
Accountants	956	261	Maintenance mechanics	1231	579
Construction workers for finishing	2414	786	Developers of ICT applications	2663	1176
Construction workers for structural works	1013	327	Operators for the chemical and plastics industry	688	292
Construction technicians	2564	1252	Other specialised administrative staff	1175	238
Commercial employees	4728	1727	Other technicians	33	9
Garment workers	131	28	Workers for sheet metal and bodywork	235	58
Print finishers	69	15	Cleaners	18652	4402
Printers	128	46	Electromechanics technicians	1915	979
Experts O&O	352	152	Process and production technicians	626	316
Specialised operators	68	25	VAC technicians	444	213
Woodworkers	107	41	Vehicle technicians	309	178
Industrial maintenance staff	609	166	Technical managers	2623	1062
Installers and electricians for construction work	2235	926	Illustrators	1419	569
Crane operators and mechanics	194	75	Textile workers	82	30
Welders	186	63	Sale support staff	2366	908
Managing logistics staff	552	135	Representatives	4471	1852

Source: VDAB

4.3.2. Geographical mismatch

The indicator usually used to determine the geographical mismatches in the labour market is the distribution of regional unemployment rates. The situation on the labour market varies considerably from one province to another (see also Figure 2 and Figure 4). This spread could mean that jobs are not available at the location where job seekers reside. However, this indicator does not indicate whether job seekers in one province have the required levels of education to fill in the available jobs in another (Zimmer, 2012).

Provincial unemployment rates per skill level are not available at Arvastat or the database from Steunpunt Werk. However, data on vacancies per sector and skill level are available. Figure 15 present a timeline of the yearly amount of vacancies received by VDAB and the amount of vacancies that remained open per year per province and skill level, for the energy, water and waste processing sector²⁶. Note that these numbers represent not only the waste processing but also the energy and water sectors and, hence, do not provide an accurate picture of the number of vacancies in the waste processing sector as such. It is nevertheless interesting to look at the general trends in this overall sector as the needs for certain job profiles will be quite similar.

The figure shows that most vacancies were received for the provinces of Antwerp and East-Flanders and that, while there was a decrease between 2011 and 2015, the amount of received vacancies has picked up in 2016. Moreover, looking at the demand per skill level for these two provinces, we can see that on average the need for high-skilled profiles is higher than that for medium and low-skilled profiles. On the contrary, the amount of low-skilled vacancies received in West-Flanders is about the same as that in East-Flanders, while the demand for high and medium-skilled labour is much lower in this province (as is the total demand). When we look at the vacancies that remained open²⁷, we see a similar trend as for the received vacancies, namely that there is a higher amount of high-skilled positions that have remained open, as compared to medium and low-skilled positions. These numbers reiterate the contrast between unemployment, where vulnerable groups (including low-skilled workers) exhibit higher rates than medium and high-skilled workers, and the demand for labour, which is higher for high-skilled workers, at least for this specific sector.

²⁶ Data in Arvastat regarding vacancies are only available at aggregated sector level, making it impossible to get information on the specific NACE codes we are interested in, such as NACE 38. We opted to only focus on the waste sector (sectors 37 to 39) as the data presented in Figure 15 might still be considered representative for these sectors. Sector 46.77, on the other hand, is a rather small sector and data collected at the aggregated level might not present a representative image.

²⁷ Please note that the scales of y-axes differ between received and open vacancies.

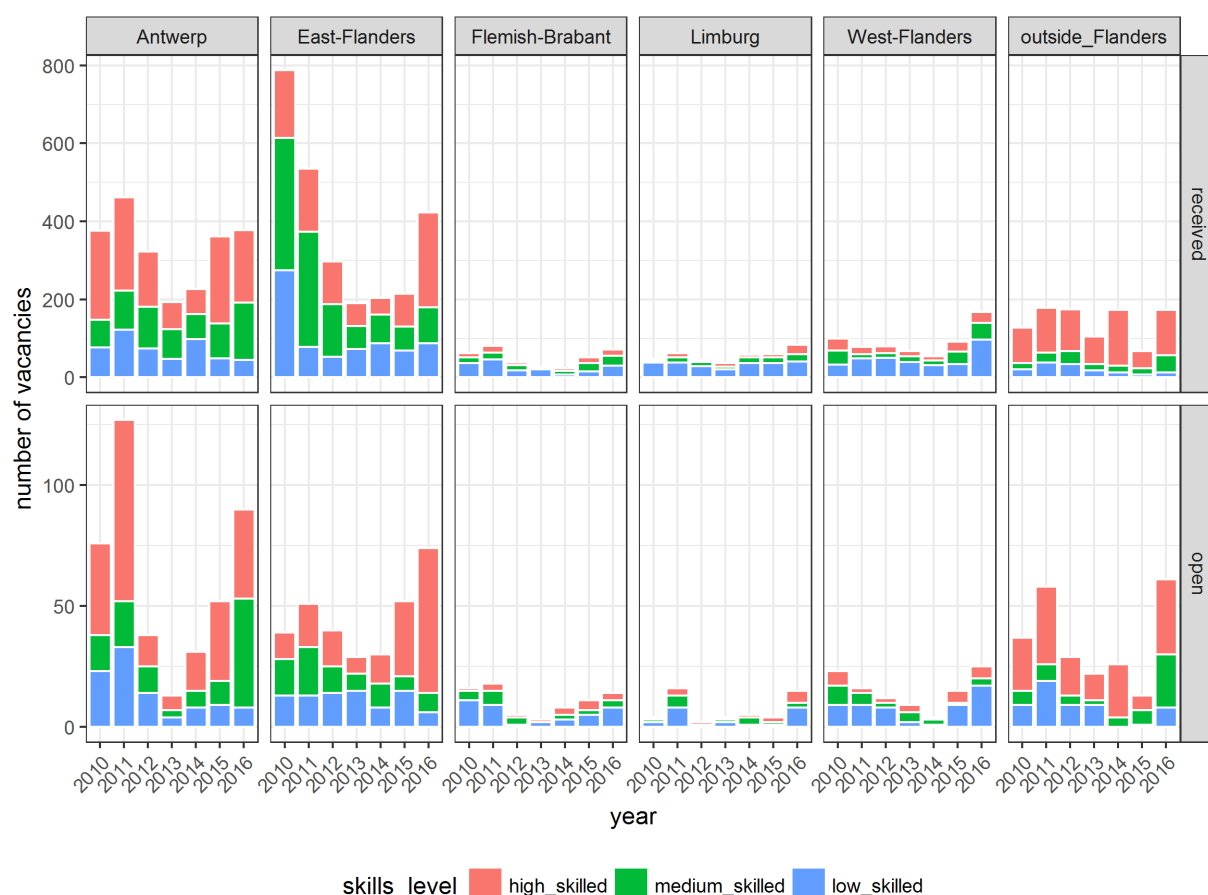


Figure 15. Overview of received and open vacancies per skill level for the 'energy, water and waste processing' sector per province from the year 2010 to 2016.

Source: Arvastat

The term “geographical mobility” refers to the home-work trips. This mobility can point to a daily or at least regular journey (commute). By offsetting the local deficits with surpluses existing elsewhere, this mobility can contribute to reducing geographical and educational mismatches between supply and demand for labour. Figure 16 provides, for Belgium but focussed on Flanders, a breakdown of the geographical location of jobs per place of residence of workers for the year 2010, as the percentage of the total employment exercised in each province (Zimmer, 2012).

The figure indicates that most of the external workforce in Brussels comes from Flanders, mainly from the neighbouring Flemish-Brabant and then from East-Flanders. People living in Wallonia take up the remainder of the jobs in Brussels. Specifically for Flanders, then, a certain degree of mobility is visible. In 2010, the provinces of Antwerp and Flemish-Brabant attracted workers from the neighbouring provinces. More specifically, over 9% of workers in East-Flanders and Flemish-Brabant came from Antwerp, and 19% of employment in Flemish-Brabant took up residence in Antwerp, Limburg or East Flanders. Limburg and West Flanders, on the other hand, have only a modest influx of commuters.

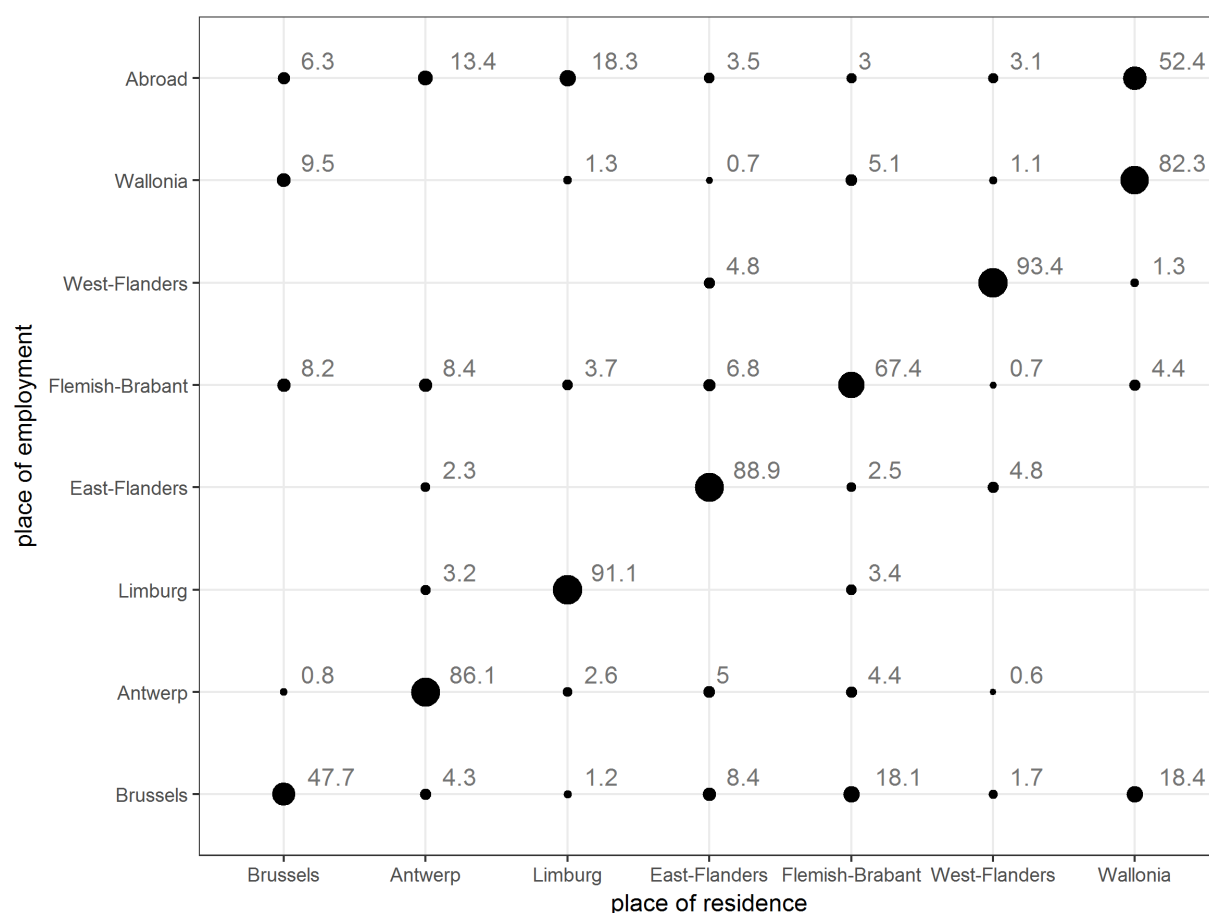


Figure 16. Breakdown of geographical location of jobs as per place of residence for the year 2010 (in % of the total employment exercised in each province).

Source: Zimmer (2012)

As already pointed out in Section 3.3, the transition to a more circular economy could help (partly) address these educational or geographical mismatches. In a more circular economy, the intensity of activities such upcycling, downcycling, servitization and reuse would increase, thereby also increasing the demand for low-skilled workers. Moreover, as Table 2 shows, circular activities are located throughout the country, where some, such as remanufacturing, are more localised, and others, such as reuse, more dispersed. An increase in these activities could then also partly reduce the geographical mismatch and, hence, unemployment.

4.4. The changing position of low-skilled labour on the labour market

Even though this review focuses on all skill levels of labour in the CE, this section explains the relevance of low-skilled labour on the labour market. Definitions as to what constitutes low, medium and high-skilled labour differ per country and region. We therefore use the Flemish definitions, developed by the Flemish Service for Employment and Vocational Training Study Office or VDAB ('Vlaamse Dienst voor Arbeidsbemiddeling en Beroepsopleiding'), presented in Table 8.

Table 8. Overview of skill levels in Flanders.

Low skill level	Medium skill level	High skill levels
Primary education	Third degree secondary education	Professional bachelor
First degree secondary education	Study certificate third grade vocational secondary education	Academic bachelor
Second degree secondary education	Higher professional education ('hoger beroepsonderwijs HBO')	Master
Apprenticeship ('leertijd', Syntra)	Secondary after secondary education ('Secundair-na-Secundair Se-N-Se')	
Part-time vocational secondary education ('bijzonder secundair onderwijs BSO')	Study certificate fourth grade vocational secondary education	

Source: Studiedienst VDAB (2013)

Our current society is continually making higher demands on the workforce. The evolution towards a services and knowledge economy has accelerated in recent years due to the increasing globalization. The growth segments of the economy require more and more highly educated people with specific skills needs. Already low-skilled workers find it more difficult to find or keep a job for years and they run a higher risk of (long-term) unemployment.

An analysis carried by VDAB found that low-skilled workers have the highest chance of becoming unemployed, as well as the lowest chance of staying employed after finding a job. As a result, about one in two job seekers in Flanders is low-skilled and their unemployment rate is three times higher than that of the highly skilled (i.e., 7.1% for the low-skilled, 3.1% for the medium-skilled and 2.1% for the highly skilled in 2011) (Studiedienst VDAB, 2013).

Moreover, according to the Cedefop 2016 skills forecast (Cedefop, 2016, n.d.), the general Belgian²⁸ employment growth rate²⁹ for high en medium-skilled labour is expected to rise by 1.3 and 0.2% respectively, from 2018 to 2030, while the growth rate for low-skilled labour is expected to decrease by 2.9%. The general European forecasts predict a 1.8% increase for the highly skilled, a 0.5% decrease for the medium-skilled, and a 2.5% decrease for the low-skilled. Cedefop forecasts take into account global economic developments up to May 2017. The EU economy as a whole is expected to grow in 2018 and 2019, albeit at a slower pace than in 2017, supported by rising household spending and falling unemployment, although wage growth remains moderate. It is also expected that investments will increase in view of the favourable financing conditions and improved economic outlook. The main assumptions included the Eurostat population forecast and the short-term macroeconomic outlook prepared by the

²⁸ Some data is only available at the Belgian level. For the remainder of this document we will make the clear distinction between data made available at the Flemish or Belgian level.

²⁹ Employment refers to the number of people in work (headcount) or the number of occupied jobs in the economy. As employed is considered the one who worked at least one hour in reference period for financial or non-financial reward. Employment trends present the development of the employed persons in different sectors, occupations and qualification (Cedefop, n.d.). The employment growth rate is defined as the ratio of the employed to the working age population.

European Commission's Directorate-General for Economic and Financial Affairs in May 2017. A possible transition to a more circular economy in the mid to long term is not taken into account.

As Section 3.3 indicated, the transition to a more circular economy offers opportunities at all skill levels, depending on the type of activity. Especially an increase in recycling and reuse could stimulate low-skilled labour opportunities.

5. Conclusion and discussion

The objective of this study was to gain insight in how the transition to a more circular economy could impact the labour market, with a focus on net job creation or loss, job creation at different skill levels, and geographical job concentration. The methodology used was a combination of literature review and exploratory data analysis, the latter mainly focused on the Belgian region of Flanders.

As many different definitions exist that describe 'circular economy', a combination of concepts was chosen to investigate the impact on the labour market.

The literature review showed that, generally speaking, studies quantifying the job impact of the circular economy forecast a net increase in jobs, although some existing jobs might be lost. Moreover, depending on the type of action contained within the "circular economy", i.e. reduce, reuse, and recycle, the impacts of a "more circular economy" vary for the different levels of skilled labour (low, medium, high-skilled) and geographical location (local, regional, global). Additionally, while certain existing occupations might be lost, new occupations might be created (job substitution and job creation), or similar changes might occur at the job activity level where some specific tasks might be replaced by others (job transformation). Finally, the impact of circular design and innovation on the labour market depends on the area in which the innovation occurs.

Focusing on the labour market characteristics in Flanders, the exploratory data analysis indicated that the group of non-working job seekers is disproportionately made up of low-skilled labour and other vulnerable groups, such as older workers, long-term unemployed, non-natives and people with an occupational disability. We expect that a transition to a more circular economy will positively affect employment for these vulnerable groups and reduce overall unemployment. Moreover, the transition has the potential to reduce the educational and geographical mismatches currently present in the Flemish labour market. However, the specific impact on vulnerable groups depends on the specific opportunities of the circular economy in Flanders, which might be different from opportunities in other countries and regions. It is also important to not only look at the number of jobs that can be created but also the quality of these jobs. The research that has been conducted so far indicates that some jobs in the waste sector are 'dirty jobs'. More research into working conditions in circular economy jobs is hence needed.

This paper did not offer an integral view of employment in the circular economy. A couple of topics fall outside the scope of this literature review. First of all, it is important to keep in mind that the creation of jobs through a more circular economy is not the only thing that matters. The literature indicated that some circular activities, such as repair, maintenance and recycling, lend themselves very well for job creation. However, we cannot draw conclusions for the whole economy. If jobs are created locally, they might disappear in other, mostly low-wage, countries. Also, the manufacturing sector for instance might experience job losses as less new products are made. This does not necessarily have to be a bad thing as this freed-up labour could be used to provide labour for alternative activities that lead to a better fulfilment of human needs, with less use of primary resources. The demand for some of these activities will rise spectacularly in the years to come, such as taking care of the elderly in a nursing home. Secondly, if we want a more circular world, there needs to be, not only a tax shift from labour to primary resources, but also an increase in wage level of workers in low-wage countries. This will increase the price

of their (linear economy) products and make it interesting for the consumer to use products for a longer period of time instead of throwing them away. Finally, in our analysis we only looked at formal employment. Nevertheless, informal labour in the circular economy does exist, for instance, some parts of the sharing economy or repair cafes, etc., and is a relevant type of labour as some informal initiatives later become formal. As this type of labour is informal it is not contained in the GDP or economic data.

Bibliography

- All-Party Parliamentary Sustainable Resource Group, 2014. Remanufacturing: Towards a resource efficient economy 1–12.
- Bachus, K., Van Dyck, L., Van Eynde, S., 2016. Quicksan jobpotentieel van de circulaire economie.
- Bakker, C., Wang, F., Huisman, J., Den Hollander, M., 2014. Products that go round: Exploring product life extension through design. *J. Clean. Prod.* 69, 10–16.
<https://doi.org/10.1016/j.jclepro.2014.01.028>
- Bårdsen, G., Nymoen, R., 2008. Macroeconometric modelling for policy.
- Bastein, T., Roelofs, E., Rietveld, E., Hoogendoorn, A., 2013. Kansen voor de circulaire economie in Nederland, TNO-rapport 2013 R10864.
- Beck, R., 2001. US recycling economic information study. Prep. Natl. Recycl. Coalition. Environ. Prot. Agency.
- Berg, J., 2016. Income security in the on-demand economy : Findings and policy lessons from a survey of crowdworkers, Conditions of Work and Employment Series No. 74.
<https://doi.org/10.1525/sp.2007.54.1.23>.
- Blomsma, F., Brennan, G., 2017. The Emergence of Circular Economy: A New Framing Around Prolonging Resource Productivity. *J. Ind. Ecol.* 21, 603–614.
<https://doi.org/10.1111/jiec.12603>
- Bocken, N.M.P., de Pauw, I., Bakker, C., van der Grinten, B., 2016. Product design and business model strategies for a circular economy. *J. Ind. Prod. Eng.* 33, 308–320.
<https://doi.org/10.1080/21681015.2016.1172124>
- Bocken, N.M.P., Short, S.W., 2016. Towards a sufficiency-driven business model: Experiences and opportunities. *Environ. Innov. Soc. Transitions* 18, 41–61.
<https://doi.org/10.1016/j.eist.2015.07.010>
- Braungart, M., Bondesen, P., Kälin, A., Gabler, B., 2008. Specific Public Goods for Economic Development: With a Focus on Environment. in British Standards Institution (eds), Public Goods for Economic Development. Compendium of Background papers, United Nations Industrial.
- Cahuc, P., Zylberberg, A., 1996. Economie du travail : la formation des salaires et les déterminants du chômage.
- Cambridge Econometrics, n.d. E3ME: Our Global Macro-econometric Model [WWW Document]. URL <https://www.camecon.com/how/e3me-model/> (accessed 2.7.18).
- Cedefop, 2017. People, machines, robots and skills.
- Cedefop, 2016. Future skill needs in Europe: critical labour force trends, Cedefop research paper; No. 49 (No. No. 59), Cedefop research paper. <https://doi.org/10.2801/56396>
- Cedefop, n.d. Cedefop employment trends [WWW Document]. URL <http://www.cedefop.europa.eu/en/publications-and-resources/data->

- visualisations/employment-trends (accessed 1.10.18).
- Circular Economy Practitioner Guide, n.d. Repurposing [WWW Document]. URL <http://ceguide.org/Strategies-and-examples/Dispose/Repurposing> (accessed 11.22.17).
- Circular Economy Toolkit, n.d. Circular Economy toolkit - maintenance [WWW Document]. URL <http://circulareconomytoolkit.org/maintain-repair.html> (accessed 11.22.17).
- CIWMB, 2003. Diversion Is Good for the Economy: Highlights from Two Independent Studies on the Economic Impacts of Diversion in California, California Integrated Waste Management Board (<http://www.calrecycle.ca.gov/publications/Economics/41004002.pdf>).
- Coats, E., Benton, D., 2016. Job quality in a circular economy.
- Coats, E., Benton, D., 2015. Unemployment and the circular economy in Europe: a study of opportunities in Italy, Poland and Germany.
- Codagnone, C., Biagi, F., Abadie, F., 2016b. The Future of Work in the “Sharing Economy”. Market Efficiency and Equitable Opportunities or Unfair Precarisation? Institute for Prospective Technological Studies, JRC Science for Policy Report EUR 27913 EN. <https://doi.org/10.2791/431485>
- Codagnone, C., Biagi, F., Abadie, F., 2016a. The Passions and the Interests: Unpacking the “Sharing Economy”. Institute for Prospective Technological Studies, JRC Science for Policy Report EUR 27914 EN. <https://doi.org/10.2139/ssrn.2793901>
- Codagnone, C., Martens, B., 2016. Scoping the Sharing Economy: Origins, Definitions, Impact and Regulatory Issues. JRC Technical Report. Institute for prospective technological studies digital economy working paper 2016/01. JRC100369. <https://doi.org/10.2139/ssrn.2783662>
- De Coen, A., Vanoeteren, V., Broos, E., Devoldere, I., 2017. Vanuit de kinderschoenen naar de puberteit - De Vlaamse deeleconomie in kaart gebracht.
- De Groen, W., Maselli, I., 2016. The Impact of the Collaborative Economy on the Labour Market. CEPS Special Report N°138.
- De Groene Zaak, 2015. Governments going circular 32.
- De Groene Zaak, Ethica, 2015. Boosting Circular Design for a Circular Economy 1–25.
- Degryse, C., 2016. Digitalisation of the economy and its impact on labour markets, ETUI Working Paper.
- Drahokoupil, J., Fabo, B., 2016. The platform economy and the disruption of the employment relationship, ETUI Policy Brief.
- Dubois, M., Christis, M., 2014. Verkenndende analyse van het economisch belang van afvalbeheer, recyclage en de circulaire economie voor Vlaanderen.
- Ecotec, 2002. Analysis of the EU Eco-Industries, their Employment and Export Potential 44, 1–10.
- Ellen MacArthur Foundation, 2013. Towards the Circular Economy. Ellen MacArthur Found. 1, 1–96. <https://doi.org/10.1162/108819806775545321>
- Ellen MacArthur Foundation, McKinsey, SUN, 2015. Growth within: a circular economy vision

- for a competitive Europe, Ellen MacArthur Foundation. <https://doi.org/Article>
- Eurofound, 2012. Fifth European Working Conditions Survey, Publications Office of the European Union, Luxembourg.
- European Commission, 2016a. COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS. A European agenda for the collaborative economy. COM(2016) 356 final.
- European Commission, 2016b. SWD(2016)184/F1 - COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS - A European agenda for the collaborative economy. <https://doi.org/10.1017/CBO9781107415324.004>
- European Commission, 2008. Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain directives. Off. J. Eur. Union L13, 3–30. <https://doi.org/2008/98/EC.; 32008L0098>
- European Environment Agency, 2011. Earnings, jobs and innovation: the role of recycling in a green economy. <https://doi.org/10.2800/84050>
- Eurostat, 2012. Economy-wide material flow accounts (EW-MFA). Compilation guide 2012. Luxembourg: Eurostat.
- Eurostat, 2008. Statistical classification of economic activities in the European Community. NACE Rev. 2. <https://doi.org/KS-RA-07-015-EN-N>
- Eurostat, n.d. Wages and labour costs [WWW Document]. URL http://ec.europa.eu/eurostat/statistics-explained/index.php/Wages_and_labour_costs#Labour_costs (accessed 3.12.18).
- Feng, Z., Yan, N., 2007. Putting a circular economy into practice in China. *Sustain. Sci.* 95–101.
- Fischer, C., Bakas, I., Bjørn, A., 2011. Green economy and recycling in Europe, ETC/SCP working paper 5/
- Friends of the Earth, 2010. More jobs, less waste: Potential for job creation through higher rates of recycling in the UK and EU.
- Geissdoerfer, M., Savaget, P., Bocken, N.M.P., Hultink, E.J., 2017. The Circular Economy – A new sustainability paradigm? *J. Clean. Prod.* 143, 757–768. <https://doi.org/10.1016/j.jclepro.2016.12.048>
- Ghisellini, P., Cialani, C., Ulgiati, S., 2016. A review on circular economy: The expected transition to a balanced interplay of environmental and economic systems. *J. Clean. Prod.* 114, 11–32. <https://doi.org/10.1016/j.jclepro.2015.09.007>
- Gilli, H., James, H., 2001. Deconstruction and the reuse of construction materials, in: CIB Publication 266 Proceedings of the CIB Task Group 39 – Deconstruction Meeting CIB World Building Congress 6 April 2001. pp. 98–124. <https://doi.org/10.1117/12.417282>
- Grady, B., 2016. The circular economy as a \$1 trillion opportunity [WWW Document]. URL <https://www.greenbiz.com/article/circular-economy-1-trillion-opportunity> (accessed 2.5.18).

- Greenaway, D., Leyborne, S., Reed, G., Whalley, J., 1993. Applied general equilibrium modelling: applications, limitations and future developments. London: The Stationary Office.
- Gregson, N., Crang, M., Botticello, J., Calestani, M., Krzywoszynska, A., 2016. Doing the 'dirty work' of the green economy: Resource recovery and migrant labour in the EU. *Eur. Urban Reg. Stud.* 23, 541–555. <https://doi.org/10.1177/0969776414554489>
- Haas, W., Krausmann, F., Wiedenhofer, D., Heinz, M., 2015. How circular is the global economy?: An assessment of material flows, waste production, and recycling in the European union and the world in 2005. *J. Ind. Ecol.* 19, 765–777. <https://doi.org/10.1111/jiec.12244>
- Hogg, D., Mulcahy, K., Elliott, T., Fletcher, D., 2011. From waste to work: the potential for a deposit refund system to create jobs in the UK.
- Huws, U., 2014. Labor in the global digital economy: the cybertariat comes of age, New York, Monthly Review Press.
- Illinois Department of Commerce and Economic Opportunity, 2006. A Report on Electronics Equipment Disposal and Recycling.
- ILO, 2011. Skills for Green Jobs - A Global View, Synthesis Report based on 21 country studies.
- ILO, 2008. ISCO 2008: Definitions of Major Groups, Sub-Major Groups, Minor Groups and Unit Groups.
- ILO, n.d. ISCO [WWW Document]. URL <http://www.ilo.org/public/english/bureau/stat/isco/docs/intro1.htm> (accessed 3.12.18).
- Inc.com, n.d. Remanufacturing [WWW Document]. URL <https://www.inc.com/encyclopedia/remanufacturing.html> (accessed 2.5.18).
- Kane, G.C., 2016. Crowd-Based Capitalism? Empowering Entrepreneurs in the Sharing Economy, MIT SLOAN MANAGEMENT REVIEW, Reprint #57327. Kathan,.
- Keynes, J.M., 1933. Essays in Persuasion. MacMillan And Co., Limited, London.
- Kibert, C.J., Languell, J.L., 2000. Implementing Deconstruction in Florida : Materials Reuse Issues , Disassembly Techniques , Economics and Policy.
- Kirchherr, J., Reike, D., Hekkert, M., 2017. Conceptualizing the Circular Economy: An Analysis of 114 Definitions. *Resour. Conserv. Recycl.* 127, 221–232. <https://doi.org/10.1016/j.resconrec.2017.09.005>
- Komosie, 2016. De kringwinkelsector in 2016.
- Lansink, A., 2017. Challenging changes - Connecting waste hierarchy and circular economy. LEA Nijmegen, the Netherlands.
- Lewandowski, M., 2016. Designing the business models for circular economy-towards the conceptual framework. *Sustain.* 8, 1–28. <https://doi.org/10.3390/su8010043>
- Lovett, G., 2014. What The Circular Economy Means For Marketers [WWW Document]. URL http://www.cmo.com/features/articles/2014/11/13/what_the_circular_ec.html#gs.Lv5_12g (accessed 2.5.18).
- Maselli, I., Lenaerts, K., Beblavý, M., 2016. Five things we need to know about the on-demand

- economy. CEPS Essay No. 21 / 8 January 2016.
- McDonough, W., Braungart, M., 2002. *Cradle to Cradle: Remaking the Way We Make Things*. North Point Press, New York.
- McKinsey & Company, 2017. Digitally-enabled automation and artificial intelligence: Shaping the future of work in Europe's digital front-runners.
- Michelin, n.d. Michelin Fleet Solutions [WWW Document]. URL <https://www.michelintruck.com/services-and-programs/michelin-fleet-solutions/> (accessed 2.6.18).
- Morgan, J., Mitchell, P., 2015a. Opportunities to tackle Britain's labour market challenges through growth in the circular economy. <https://doi.org/10.13140/RG.2.1.5171.6566>
- Morgan, J., Mitchell, P., 2015b. Employment and the circular economy - Job creation in a more resource efficient Britain. <https://doi.org/10.13140/RG.2.1.1026.5049>
- Openbare Vlaamse Afvalstoffenmaatschappij, 2017. Huishoudelijk afval en gelijkaardig bedrijfsafval 2016 - Opvolging van de indicatoren in het uitvoeringsplan.
- Organisation for Economic Cooperation and Development, 2015. Economic benefits of the circular economy - a critical review of the literature and opportunities for CGE modelling, paper prepared for the 6th meeting of the WPRPW.
- Organization for Economic Cooperation and Development, 2017. The macroeconomics of the circular economy transition: a critical review of modelling approaches - ENV/EPOC/WPRPW/WPIEEP(2017)1/FINAL.
- Organization for Economic Cooperation and Development, 2016. OECD Tourism Trends and Policies 2016. <https://doi.org/10.1787/tour-2012-en>
- Parker, D., Riley, K., Robinson, S., Symington, H., Tewson, J., Jansson, K., Ramkumar, S., Peck, D., 2015. Remanufacturing Market Study, European Remanufacturing Network.
- Philips Healthcare, 2014. Refurbishing solutions for MRI systems [WWW Document]. URL <https://www.philips.com/c-dam/corporate/about-philips/sustainability/sustainable-planet/circular-economy/refurbished-medical-products/case-study-ce-philips-healthcare.pdf> (accessed 2.5.18).
- Pollitt, H., Alexandri, E., Chewpreecha, U., Klaassen, G., 2015. Macroeconomic analysis of the employment impacts of future EU climate policies. *Clim. Policy* 15, 604–625. <https://doi.org/10.1080/14693062.2014.953907>
- Porter, M.E., van der Linde, C., 1995. Toward a New Conception of the Environment-Competitiveness Relationship. *J. Econ. Perspect.* 9, 97–118.
- Ren, Y., 2007. The circular economy in China. *J. Material Cycles Waste Manag. J. Mater. Cycles Waste Manag.* 121–129.
- Rennings, K., Ziegler, A., Zwick, T., 2004. The effect of environmental innovations on employment changes: an econometric analysis. *Bus. Strateg. Environ.* 13, 374–387.
- Rennings, K., Zwick, T., 2012. *Employment Impacts of Cleaner Production*. Springer Science & Business Media.
- RREUSE, 2015. Briefing on job creation potential in the re-use sector 1–6.

- Sakai, S., Yoshida, H., Hirai, Y., Asari, M., Takigami, H., Takahashi, S., Tomoda, K., Peeler, M.V., Wejchert, J., Schmid-Unterseh, T., Douvan, A.R., Hathaway, R., Hylander, L.D., Fischer, C., Oh, G.J., Jinhui, L., Chi, N.K., 2011. International comparative study of 3R and waste management policy developments. *J. Mater. Cycles Waste Manag.* 13, 86–102. <https://doi.org/10.1007/s10163-011-0009-x>
- Schaffartzik, A., Eisenmenger, N., Gingrich, S., Mayer, A., Krausmann, F., 2014. The global metabolic transition: Regional patterns and trends of global material flows, 1950–2010. *Glob. Environ. Chang.* 26, 87–97.
- Stahel, W.R., 2013. Policy for material efficiency - sustainable taxation as a departure from the throwaway society. *Philos. Trans. R. Soc. A Math. Phys. Eng. Sci.* 371, 20110567–20110567. <https://doi.org/10.1098/rsta.2011.0567>
- Stahel, W.R., 2010. *The Performance Economy*, Second Edi. ed. Palgrave Macmillan.
- Stahel, W.R., 2010. *The performance economy: 2nd edition*, *The Performance Economy: 2nd Edition*. <https://doi.org/10.1057/9780230274907>
- Stahel, W.R., 1982. *The product-life factor*.
- Studiedienst VDAB, 2013. *Kansengroepen in Kaart*.
- Studiedienst VDAB, 2012. *Kansengroepen in Kaart. Allochtonen op de Vlaamse arbeidsmarkt*.
- Studiedienst VDAB, 2010a. *Arbeidsgehandicapten op de Vlaamse arbeidsmarkt*.
- Studiedienst VDAB, 2010b. *Analyse Vacatures 2010 - Knelpuntberoepen*.
- Sue Wing, I., 2009. Computable General Equilibrium Models for the Analysis of Energy and Climate Policies, in: *International Handbook on the Economics of Energy*. pp. 332–366. https://doi.org/10.1142/9789814289238_0009
- Tamma, P., Hervey, G., 2018. Getting wasted: Hope for circular economy jobs could be a waste. *Politico*.
- Todoli-Signes, A., 2017. The ‘gig economy’: employee, self-employed or the need for a special employment regulation? *Eur. Rev. Labour Res.* 23, 193–205.
- UK Energy Research Centre, 2014. *Low carbon jobs : The evidence for net job creation from policy support for energy efficiency and renewable energy*.
- VITO, n.d. *Input-Output Analysis [WWW Document]*. URL <https://vito.be/en/materials/policy-for-the-transition-to-a-green-circular-economy/input-output-analysis> (accessed 2.6.18).
- Weghmann, V., n.d. *Waste management in Europe. Good jobs in the Circular economy? A report commissioned by EPSU*.
- Wijkman, A., Skånberg, K., 2015a. *The Circular Economy and Benefits for Society: Jobs and Climate Clear Winners in an Economy Based on Renewable Energy and Resource Efficiency. A study pertaining to Finland, France, the Netherlands, Spain and Sweden*.
- Wijkman, A., Skånberg, K., 2015b. *The Circular Economy and Benefits for Society: Jobs and Climate Clear Winners in an Economy Based on Renewable Energy and Resource Efficiency. A study pertaining to the Czech Republic and Poland*.
- WRAP, 2015. *Economic Growth Potential of More Circular Economies*, prepared by Peter Mitchell, Head of Economics, WRAP and Keith James, Special Adviser on Environmental

Research, WRAP. <https://doi.org/10.13140/RG.2.1.1026.5049>

Zimmer, H., 2012. Mismatches op de arbeidsmarkt. Econ. Tijdschr. 59–74.

CE CENTER
CIRCULAR
ECONOMY
POLICY RESEARCH
CENTRE

WE MAKE
TOMORROW
BEAUTIFUL
OVAM

DEPARTMENT OF
ECONOMY
SCIENCE &
INNOVATION

Disclaimer:

This publication reflects the views only of the author, and the Flemish Government cannot be held responsible for any use which may be made of the information contained therein.

ce-center.be

