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regio **amsterdam**

 **CIRCLE**  
ECONOMY

 **EHERO**  
Erasmus Happiness Economics Research Organisation

# CIRCULAR JOBS & SKILLS

IN THE AMSTERDAM  
METROPOLITAN AREA



# INTRODUCTION

## A circular economy to tackle global challenges

Our current economic system is vastly unsustainable. Each year, over ~84.4 billion tonnes of resources are extracted<sup>1</sup> to be consumed in a system that is increasing both climate change,<sup>2</sup> and income inequality.<sup>3</sup> However, the circular economy is increasingly recognised as a viable alternative to the current 'take-make-waste' system. In a circular economy, resources are cycled in closed 'loops' while maintaining the highest value for as long as possible, and is comprised of seven key elements (presented on the right). Ultimately, the circular economy offers a paradigm to decouple both economic and societal prosperity from environmental degradation.

## Cities as catalysts of a sustainable future

For the first time in human history, more than 55% of the global population live in cities, with this share expected to rise to two thirds by 2050.<sup>4</sup> This growth in the number of urban citizens has aggregated and aggravated key societal challenges within the urban environment, and cities today face huge societal challenges, such as unemployment, and poverty<sup>3</sup>, while also fuelling environmental crises, such as climate change<sup>5</sup>. Yet, this concentration of people within cities also provides the spark for innovation and collaboration, making cities the ideal test-beds for the circular solutions.

## Employment within a circular economy

The circular economy presents an economically viable alternative to the current exploitative global system, with new business innovations opening up new opportunities to generate new forms of value<sup>8</sup>. Recent estimates have highlighted the potential of the circular economy to generate net employment increases of ~700,000 in the EU by 2030<sup>9</sup>. Yet, a systemic shift towards the circular economy will change the type of work that will be done, how it is carried out, and by who.

## Amsterdam (Metropolitan Area) pioneering the circular economy

Building upon the Dutch national strategy,<sup>6</sup> the Amsterdam has committed to becoming fully circular by 2050<sup>10</sup>. It has started the journey to become a circular city with the Circle City in 2015, and has since then started more than 70 pilots in the circular economy. Amsterdam have pioneered a learning by doing approach in the circular economy, which has been evaluated in 2017.

The Amsterdam Metropolitan Area (AMA) comprises the broader region around Amsterdam and inhabits well over 2.4 million people across 33 municipalities.

## Circular employment in Amsterdam (Metropolitan Area)

In order for the AMA to most effectively transition towards, and maximise the benefits of, a circular economy, it is important to study the character of circular employment within the region, and further understand how to develop the necessary skills to accelerate the circular transition. What will the transition towards a circular economy mean for employment in cities?

This research provides insight into (1) the baseline situation of circular employment, (2) skills needed in the circular economy and (3) action perspectives for policy makers. This report summarises the key findings from the full report "jobs and skills in the MRA" that was originally pushed in Dutch. These insights and action perspectives from Amsterdam create valuable insights for other cities that want to prepare their workforce for the transition towards a circular economy.

### What is a circular job?

Employment in the circular economy reflects the broad nature of the concept and can equally be defined according to the 7 key elements of the circular economy presented to the right. The circular labour market is comprised of all kinds of jobs in different sectors, ranging from waste management to the creative industries. The examples on the right illustrate the types of directly circular jobs that follow each of the 7 elements:

- Core circular jobs. These jobs ensure that raw material cycles are closed and thus form the core of the circular economy.
- Enabling circular jobs. These jobs enable acceleration and upscaling of primary circular activities and thus form the supporting shell of the circular economy.
- Indirect circular jobs: All other sectors that provide services to primary and that create supporting circular activities.

# 7 KEY ELEMENTS OF THE CIRCULAR ECONOMY

## CORE STRATEGIES



### Prioritise regenerative resources

Ensure renewable, reusable, non-toxic resources are utilised as materials and energy in an efficient way. Example circular job: Solar panel installer.



### Preserve & extend what's already made

While resources are in-use, maintain, repair and upgrade them to maximise their lifetime and give them a second life through take back strategies when applicable. Example circular job: Appliance technician



### Use waste as a resource

Utilise waste streams as a source of secondary resources and recover waste for reuse and recycling. Example circular job: Recycling operative



### Rethink the business model

Consider opportunities to create greater value and align incentives through business models that build on the interaction between products and services. Example circular job: Leasing process manager

## ENABLING STRATEGIES



### Collaborate to create joint value

Work together throughout the supply chain, internally within organisations and with the public sector to increase transparency and create joint value. Example circular job: Director of a trade association



### Design for the future

Account for the systems perspective during the design process, to use the right materials, to design for appropriate lifetime and to design for extended future use. Example circular job: Architect



### Incorporate digital technology

Track and optimise resource use and strengthen connections between supply chain actors through digital, online platforms and technologies that provide insights. Example circular job: Data analyst

\*Further information on the types of circular employment can be found in the 2017 report: "CIRCULAR JOBS Understanding Employment in the Circular Economy in the Netherlands"<sup>10</sup>

# CIRCULAR EMPLOYMENT IN THE AMSTERDAM METROPOLITAN AREA

## 11% of employment is circular in the Amsterdam Metropolitan Area

Of the total ~1.3 million jobs within the Amsterdam Metropolitan Area (AMA) in 2016, 11 percent are circular\*. This corresponds to approximately 140,000 circular jobs in the AMA, 63,500 of which are located within the City of Amsterdam itself.

When compared to the Netherlands as a whole, the highly urbanised region of the AMA boasts a greater overall share of circular employment, with a significant orientation towards enabling activities. As with many other urban regions and cities throughout Europe, the AMA is characterised by its strong service-based economy, with the circular economy similarly reflecting this orientation. The AMA, thus, holds a strong position to enable the transition towards a circular economy.

## Amsterdam excels in digital technology and circular design

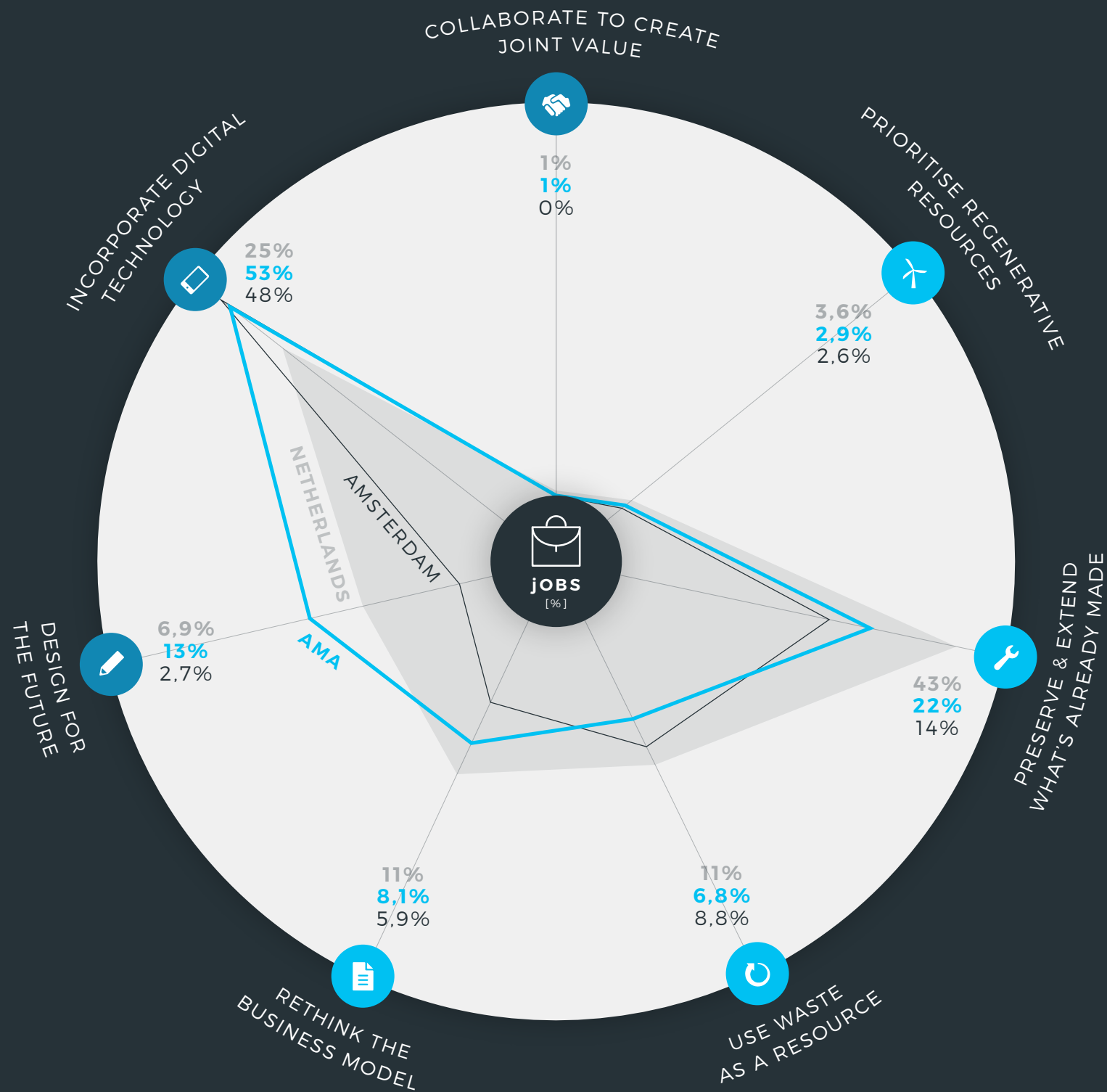
Breaking down circular employment into the key elements of the circular economy, the AMA showcases distinct specialisation in the enabling jobs of Incorporate Digital Technology and Design for the Future, with over half of all circular employment in the region relating to the former. These circular jobs relate to region's strong position in service-based and creative economies. This underlying character of the region serves to shape the nature its role in the transition towards the circular economy, both within and beyond its borders.

## Many jobs to extend the lifespan of products

Although occupying a lesser share than the Netherlands as a whole, in an absolute sense, AMA contains a high number of jobs in Preserve and extend what's already made. These jobs are focused, on the one hand, on the repair of consumer goods and high-tech goods, and on the other hand, on trade in second-hand goods. With a total population of ~2.3 million people in the AMA, the significance of these circular jobs is unsurprising, stimulated by the high concentration of consumer goods, providing many opportunities for reuse and repair.

\* A full explanation of the circular employment methodology can be found in Appendix A.

# CIRCULAR EMPLOYMENT PER KEY ELEMENT



8% CIRCULAR EMPLOYMENT THE NETHERLANDS

11% CIRCULAR EMPLOYMENT AMSTERDAM METROPOLITAN AREA



# CIRCULAR EMPLOYMENT IN THE AMSTERDAM METROPOLITAN AREA

## Urban centres cluster circular employment

The map on this page presents the spatial distribution of all circular employment throughout the AMA, including core, enabling and indirect circular jobs. In line with national trends,<sup>10</sup> the urban centers throughout the region also provide the largest number of circular jobs in the AMA, such as the city of Amsterdam, Haarlem, and Haarlemmermeer (Schiphol). This does not come as a surprise as urban centres agglomerate of economic activity.<sup>11</sup> Nevertheless, it serves to affirm the important role of cities within a circular economy.

What is more, within these urban areas, clear differences can be seen in the distribution of circular jobs. Enabling circular activities often concentrate in city centers, while core circular activities are usually found on urban peripheries.

## Amsterdam: a hotspot for circular design and technology

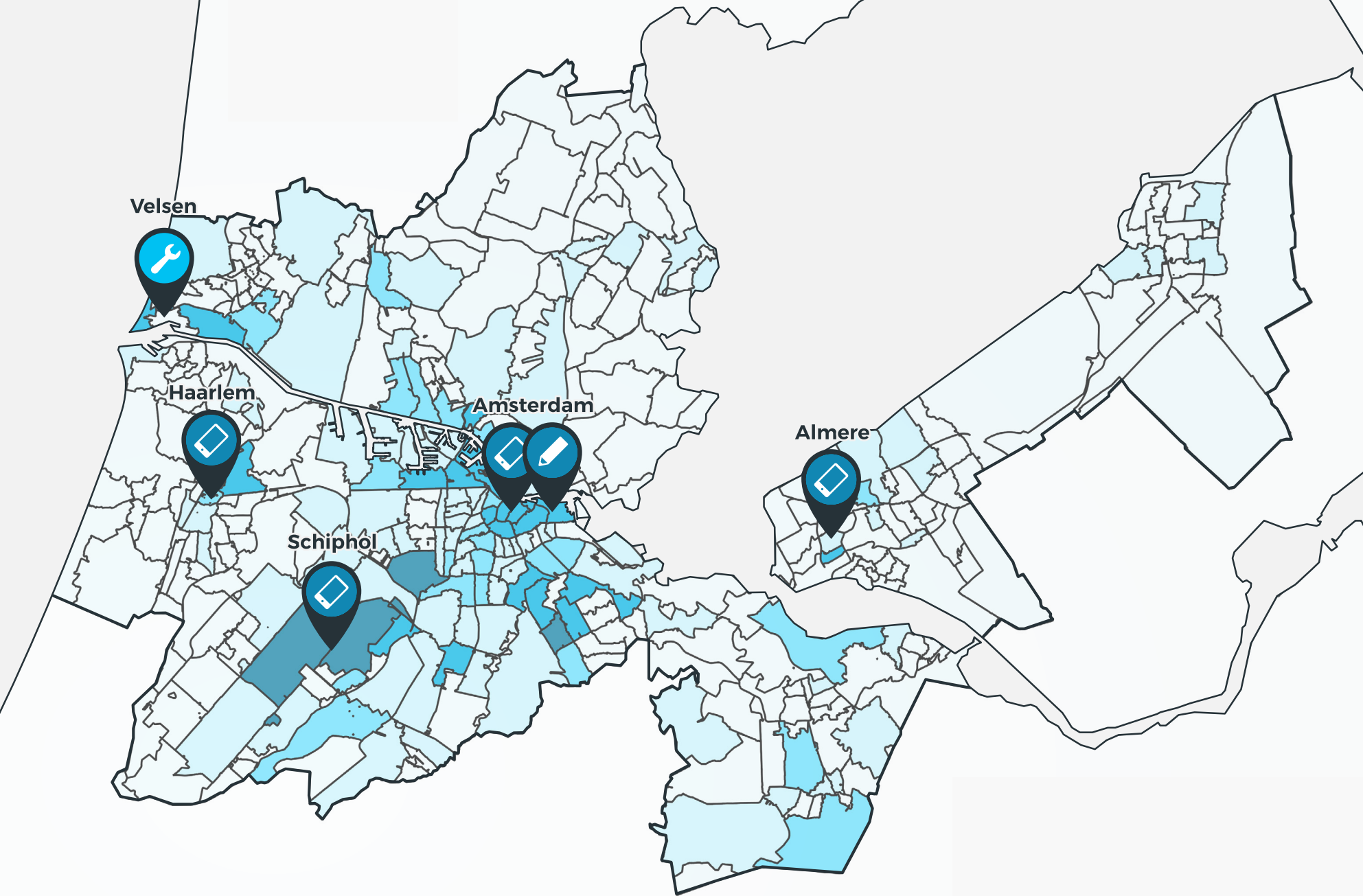
In a large number of municipalities throughout the AMA, circular employment within incorporate digital technology provides the largest share of jobs, with clear clustering in most urban centres. This is particularly prominent around the Schiphol area, and capitalises on the area's strong specialisation in the service- and knowledge-based industries.

Furthermore, jobs in Design for the future are concentrated in the larger city centers, especially Amsterdam. Ultimately, the clustering of enabling circular employment towards city centres reflects the demands of service- and knowledge- intensive industries; providing strong opportunities for knowledge transfer to drive innovation and employment within these enabling circular strategies.

## Core circular jobs clustered around industrial areas

Employment within core circular strategies tend to be clustered in urban peripheries and throughout smaller municipalities, such as throughout the North and South East of the AMA.<sup>10</sup> The location this circular employment is a result of these core circular strategies relating particularly to industrial manufacturing and processing industries, such as waste sorting and recycling facilities which are more space intensive and require effective logistical connections.

In Velsen, activities in Preserve and extend what's already made provides the greatest number of jobs, particularly related to the maintenance and repair of transport and industrial equipment, due to the presence of the steel industry in that area.



## AMA

### Total circular employment



### Circular strategies

- Preserve & extend what's already made
- Incorporate digital technology
- Design for the future

The map presents the spatial distribution of circular employment per district of the AMA (at the level of four-digit postal codes). All circular jobs are included: core, enabling and indirect. The number of circular jobs per neighborhood varies from 0 (often in sparsely populated rural areas) to more than 3,000 (in densely populated areas, industrial sites and business parks). The icons indicate hotspots of employment by key circular element.



# SKILLS FOR A CIRCULAR ECONOMY

## Circular skills for circular jobs

Pursuing a circular economy will fundamentally change the world of work.<sup>9</sup> Reshaping the type of work that will be done, by who, and how will also change the types of skills that will be needed to thrive in a circular economy. Yet, as highlighted in the previous sections, the nature of employment within a circular economy is diverse, and skill demands will, similarly reflect this diversity.

It is already being demonstrated that the employment within a circular economy opportunities throughout the diversity of the labour market; from lower skilled workers, to those that are highly educated.<sup>12</sup> This illustrates the potential of a circular economy to generate societal benefits. Yet, in order to effectively transition towards circularity, it is important to further understand and anticipate these skill requirements.

## Arming the workforce for a circular revolution

A labour market that anticipates the transition towards a circular economy can also accelerate it. For this, it is first important to define these circular skills. Six skills have been identified, ranging from basic skills, to technical skills, and are presented in detail on the right of this page.

Following this, the skill demands for employment within the circular economy must be measured and monitored for each key element of the circular economy respectively.\* In addition, an exploration into the required training levels provides important insights into the shortages and mismatches that may arise in the future labor market. This indicates the direction of the training and education programs in which investments can be made to effectively develop the labour force of the AMA.

The following section presents an overview of circular jobs and skills in each of the seven key elements of the circular economy. For each element, a fact-file is provided which details:

**Jobs:** Total contribution to circular employment in the AMA

**Occupations:** Three most important occupations

**Skills:** Which skills are needed to perform these circular jobs and occupations, and how this relates to the rest of the economy

**Knowledge-fields:** Important knowledge fields or disciplines

**Knowledge-level:** Proportion of jobs that need a university degree, traineeship, or practical work experience

**Action perspectives:** Practical actions for a city to boost these circular jobs and skills

\* A full explanation of the circular skills methodology can be found in Circle Economy & EHERO. (2017). "Circular Jobs: Understanding employment in the circular economy".

# 6 TYPES OF SKILLS

Skills relate to the ability to perform a task well. As such, employment in the circular economy requires different skill-sets than is currently demanded in a linear economy. In the O\*NET database\*, 35 skills are identified, varying from active learning and listening, to mathematics and programming. These skills are divided into six groups based on the type of activities in which they are used.<sup>13</sup>



## Basic skills

Developed capacities that facilitate learning or the more rapid acquisition of knowledge.



## Complex Problem Solving Skills

Developed capacities used to solve novel, ill-defined problems in complex, real-world settings



## Resource Management skills

Developed capacities used to allocate resources efficiently



## Social skills

Developed capacities used to work with people to achieve goals



## Systems skills

Developed capacities used to understand, monitor, and improve sociotechnical systems



## Technical skills

Developed capacities used to design, set-up, operate, and correct malfunctions involving application of machines or technological systems














\* The skill profiles of the United States show a high correlation (around 0.8) with that of Italy and the Czech Republic (the only two European surveys based on O\*NET surveys carried out), with a few minor exceptions. At the time of writing, the European Centre for the Development of Vocational Training therefore states that it is methodologically correct to apply US proficiency profiles in a European context.<sup>14</sup>















# CIRCULAR JOBS & SKILLS - FACT-FILE & ACTION PERSPECTIVES: CORE JOBS

Circular element	Circular Skills	Knowledge	Action Perspectives
 <p>Jobs in <b>Prioritise regenerative resources</b> enable to the creation of renewable energy and operation of new decentralised energy systems. In the AMA more than 2% of circular jobs (2.500 jobs) are in this strategy. The three most important professions are in the repair and maintenance, architecture and engineering, and administration sectors.</p>	    <p>Problem-solving Resource Management Systems Technical</p>	<p><b>Knowledge level:</b> Prioritise regenerative resources requires a higher educated workforce than the rest of the economy. A degree in university is more important than practical work experience.</p> <p><b>Knowledge fields:</b> The three most Important disciplines are engineering, IT and management.</p>	<ul style="list-style-type: none"><li>Jobs in this key element mainly require technical knowledge and skills, for example, for the installation and maintenance of equipment. These skills are gained through practical experience (work experience and on-the-job training). Invest in programmes to <b>promote apprenticeships</b>, and the connect education to the business community.</li><li>To increase the practical experience that is important for to develop resource management and systems thinking and complex problem-solving skills, scale-up existing public-private partnerships that <b>link vocational education to industry</b>.</li></ul>
 <p>Jobs in Preserve and extend relate to the repair and lifetime extension of products and materials. This strategy represents more than 13% (18,500) circular jobs in the AMA. Most jobs are located in the maintenance and respiration, transportation, and manufacturing sectors.</p>	  <p>Resource Management Systems</p>	<p><b>Knowledge level:</b> Preserve and extend what's already made requires a higher level of practically skilled labour compared to the rest of the economy. Thus practical work experience is relatively more important than a university degree.</p> <p><b>Knowledge fields:</b> The three most Important disciplines are engineering, design and Psychics.</p>	<ul style="list-style-type: none"><li>Jobs in this key element require a lot of practical and technically skilled work, predominantly gained through on-the-job training. Support the <b>creation of apprenticeship programmes</b> to promote technical skills and STEM knowledge.</li><li>Skills demanded by jobs in this key element are highly transferable. Look to comparable and adjacent sectors, for example the wood and metal manufacturing industries, to support the development and transfer of these skills and workers.</li></ul>
 <p>Jobs in <b>Use waste as a resource</b> relate to the valuation of residual and waste streams for new purposes. This strategy represents more than 4% (5,800) of circular jobs in AMA. Most jobs are located in the construction, transportation and management sectors.</p>	 <p>Technical</p>	<p><b>Knowledge level:</b> Use waste as a resource requires a higher level of practically skilled labour compared to the rest of the economy. Thus practical work experience is relatively more important than a university degree.</p> <p><b>Knowledge fields:</b> The three most Important disciplines are engineering and construction, logistics, and production and process control.</p>	<ul style="list-style-type: none"><li>Jobs in <b>Use waste as a resource</b> are relatively low-threshold due to the low demand of specialist skills. This ensures that work is very mobile. <b>Retrain workers</b> from similar sectors to stimulate further employment in this sector.</li><li>Practical experience is important to gain the technical skills required in jobs in this strategy. Promote the circular economy in the current <b>school curriculum</b> to enable such skills to put into practice quickly.</li></ul>
 <p>Jobs in <b>Rethink the business model</b> relate to new revenue models to accelerate the circular economy through, for example, sharing platforms and product-service systems. In the AMA, this strategy represents 5% (7,000) circular jobs. Most jobs are located in the retail, logistics, and management sectors.</p>	  <p>Resource Management Technical</p>	<p><b>Knowledge level:</b> Rethink the business model requires many new types of knowledge. Yet, jobs in this strategy are no more knowledge intensive than the rest of the economy. A university education is important is more important than practical experience.</p> <p><b>Knowledge fields:</b> The three most important disciplines are sales and marketing, computers and electronics, and process management.</p>	<ul style="list-style-type: none"><li>The skills required for jobs within this strategy commonly overlap with existing sectors, such as retail. Stimulate new circular business models through <b>further training on circular business models</b> to transform existing activities. Cover topics such as the financing of product service systems.</li><li>New business models are often implemented by SMEs, yet these businesses often have a lower capacity for internal training and education.<sup>15</sup> <b>Provide financial support and trainings to SMEs</b> to support the development of circular skills.</li></ul>



# CIRCULAR JOBS & SKILLS - FACT-FILE & ACTION PERSPECTIVES: ENABLING JOBS

Circular element	Circular Skills	Knowledge	Action Perspectives
 <p>Jobs in <b>Collaborate to create joint value</b> promote cooperation within value chains, within organizations and with the public sector. This strategy provides 1% (20) circular jobs in the AMA. Most jobs are located in business and financial services, personal services, and management sector.</p>	    <p>Problem-solving Resource Management Systems Technical</p>	<p><b>Knowledge level:</b> Jobs in this sector require a number of highly skilled workers, with most jobs requiring a university degree. Traineeships and on-the-job training are also more important than the rest of the economy</p> <p><b>Knowledge fields:</b> The three most important disciplines are communication and media, management and computers and electronics.</p>	<ul style="list-style-type: none"><li>Professional cooperation for the circular economy requires highly educated employees in very diverse knowledge fields. <b>Integrate the principles</b> of the circular economy and of joint value creation <b>in all courses in higher education.</b></li><li>As many of the required skills are developed on-the-job, as well as through education and training programmes, it is important to develop intersectoral internship and training programs. The public sector can act as a mediator between education and businesses.</li></ul>
 <p>Jobs in <b>Design for the future</b> ensure that materials and assembly techniques that extend the life of products and enable the repair and dismantling of products are adopted. In the AMA, circular design makes up 8% (10,700) of circular jobs. These jobs are mainly found in art, design and media, and manufacturing sectors.</p>	     <p>Problem-solving Resource Management Systems Technical Social</p>	<p><b>Knowledge level:</b> Jobs in circular design demand a higher level of practical skills than the rest of the economy. Thus, trainings, work experience and apprenticeships are important to develop these skills.</p> <p><b>Knowledge fields:</b> The three most important disciplines are in computers and electronics, architecture and management.</p>	<ul style="list-style-type: none"><li>Training in design benefits from an interdisciplinary approach; employees require a broad knowledge base and a multitude of skills. This holistic approach ensures impacts throughout the entire value chain are considered in the design process.</li><li><b>Integrate knowledge</b> about circular design into university and higher professional education curricula and in additional training and training programs.</li></ul>
 <p>Jobs in <b>Incorporate digital technology</b> serve to map material use and optimise value chains through digital platforms and technologies. This strategy provides 29% (41,000) circular jobs in the AMA. Jobs occur mainly within the ICT, business and financial services, and sales and marketing sectors.</p>	     <p>Basic Resource Management Systems Technical Social</p>	<p><b>Knowledge level:</b> Jobs in circular digital technology require highly skilled workers, with most jobs demanding a university degree. Traineeships and on-the-job training are also more important than the rest of the economy</p> <p><b>Knowledge fields:</b> The three most important disciplines are in computers and electronics, administration &amp; management, and communication &amp; media.</p>	<ul style="list-style-type: none"><li>Circular jobs require specific knowledge and skills and have little overlap with other sectors. It is necessary to increase the circular knowledge within this sector. Integrate circular principles in <b>education and trainings</b> in the ICT sector.</li><li><b>Focus on collaboration</b> between ICT, renewable energy (smart grids), new business models (sub-platforms) and circular design (material databases). The public sector can act as a instigator between these stakeholders.</li></ul>



# CONCLUSION

The circular economy is gaining international importance as a means to tackle the key societal challenges facing the world, and particularly cities, such as climate change, resource scarcity, quality of life and employment. The Amsterdam Metropolitan Area (AMA) has committed to becoming fully circular by 2050 and ensure circular prosperity. The circular economy offers enormous opportunities for existing and new business. However, these new opportunities translate into a changing demand for work and therefore also skills.

## 140,000 jobs in the circular economy in the AMA

11% of employment within the Amsterdam Metropolitan Area (AMA) is circular. This share is greater than the national average and corresponds to approximately 140,000 circular jobs in total.

## Amsterdam is a hotspot for digital technology, circular design and lifetime extension

Digital technology, circular design and lifetime extension are the most important elements for circular employment in the AMA, and thus, form the distinctive feature of the circular economy in the AMA. Furthermore, in line with national trends, the urban centers throughout the AMA provide the largest number of enabling circular jobs, while core circular employment is located within the urban peripheries.

## Four action perspectives to boost circular employment:

Employment with a circular economy is diverse, with the skill demands of these jobs mirroring this diversity. Yet, there are a number practical actions that municipal policy-makers can deploy to develop important circular skills within the workforce:

1. Develop necessary skills in practical experience and training through public private partnerships (between education and business) and apprenticeships. The government can play an important facilitative and connective role in this.
2. Ensure the necessary cross-sectoral collaboration and interdisciplinary thinking in the circular economy. As such, it is important to focus on early cooperation between different (professional) training courses.
3. Integrate principles of the circular economy into University programmes and schools to enable graduates from all disciplines to contribute towards the circular economy.
4. Capitalise on the competitive advantage and defining character of a city to further maximise the potential of the circular economy, as illustrated by the AMA's focus on digital technology, circular design and preserve and extend.

## Both government and business are responsible for circular skills development

Governmental organisations play a key role in the development of the right competencies for the circular economy. Yet, to more effectively development the necessary skills to boost the transition towards a circular economy, greater alignment of education programmes and business is needed. In this way, skills developed through education programmes can better match the practical talents demanded by companies. By making both the government and companies jointly responsible for the development of the necessary knowledge and skills, a higher level of alignment can be realised to develop the circular labor market.





# APPENDIX 1 - CIRCULAR EMPLOYMENT METHODOLOGY

## Method

From the work conducted by Circle Economy & EHERO (2017), a definition of the circular economy and the description of a circular job were formulated.<sup>10</sup>

A circular job is any full or part-time occupation that directly involves one of the elements of the circular economy or indirectly supports such activities.

A directly circular job includes jobs that follow core and enabling circular economy elements.

An indirectly circular job includes jobs within all other sectors of the economy that support the directly circular jobs.

Using this definition, the sectors of economic activity in the LISA database were classified as core circular, enabling circular, or indirectly circular. These classifications were made based on how well the sectors are connected to the 7 elements of the circular economy, as the table outlines below.

CIRCULAR JOBS	ECONOMIC SECTOR	7 Key Element	Example sectors 7 activities
Directly Circular Jobs	Core jobs	Prioritise regenerative resources	Renewable energy
		Preserve & extend what's already made	Repair
		Use waste as a resource	Recycling
		Rethink the business model	Renting or leasing activities
	Enabling jobs	Collaborate to create joint value	Professional & networking associations
		Design for the future	Industrial design or architecture
		Incorporate digital technology	Digital technology
Indirectly Circular Jobs	Indirectly circular		Education Government services Professional services

Regarding ‘rethink the business model,’ it should be noted that there are a number of circular business models, such as leasing and sharing strategies, that have a positive effect on resource use. These business models are very innovative and have often not yet penetrated the market on a larger scale and are therefore not yet distinguished as such in existing databases. In this methodology, all renting and leasing activities are included to represent the ‘rethink the business model’ element.

For the core circular sectors, it is assumed that 100% of the jobs are circular. For the enabling circular and indirectly circular sectors; however, not all jobs are circular and it was necessary to analyse what percentage of the jobs within these sectors can be considered circular. This analysis was done through the use of input output tables.

## Input Output Analysis

To calculate the percentage of jobs within enabling circular and indirectly circular sectors, the Use table for the Netherlands was utilised for the years 2000 to 2014. These Use tables contain the monetary values of transactions between the products of various sectors along the rows and the economic sectors that use these products along the columns. Using the classification of core, enabling, and indirectly circular sectors, the rows and columns were categorised as outlined in the table below.

	Core Circular Sectors	Enabling Circular Sectors	Indirectly Circular Sectors	Total
Core Circular Sector Products		B Core circular products used by enabling circular sectors		Total_Row
Enabling Circular Sector Products	C Enabling circular products used by core circular sectors	D Enabling circular products used by enabling circular sectors		
Indirectly Circular Sector Products	E Indirectly circular products used by core and enabling circular sectors			
Total	Total_Column			

To determine the percentage of circular jobs within enabling circular sectors, the monetary value of core circular sector products used by enabling circular sectors, the monetary value of enabling circular sector products used by enabling circular sectors, and the monetary value of enabling circular sector products used by core circular sectors was taken into consideration. Mathematically, the following calculation was performed:

{{(B+D) + (C+D)}} / {{Total\_Row + Total\_Column}} = % of enabling circular jobs

To determine the percentage of circular jobs within indirectly circular sectors, the monetary value of indirectly circular sector products used by core circular sectors and the monetary value of indirectly circular sector products used by enabling circular sectors was taken into consideration. Mathematically, the following calculation was performed:

E / Total\_Column = % of indirectly circular jobs that support directly circular jobs

These percentages were then applied to the LISA database to calculate the number of enabling and indirectly circular jobs.



# APPENDIX 2 - CIRCULAR SKILLS METHODOLOGY

## Subdivision 35 skills

The skills can be further subdivided into four task clusters based on the degree of routine and cognition they require: cognitive routine, cognitive non-routine, cognitive interpersonal and manual skills. This additional classification is useful for distinguishing between skills required for tasks with clear protocols and skills required for tasks that require creativity.

An overview of the taxonomy of the 35 skills can be found in Table 2.

The assessment of the 35 skills required for each profession was carried out by professional analysts. These analysts have obtained information about the title and definition of the occupation, the required level of professional preparation, knowledge background and the importance of work activities and context for which the relevant skill is required. For each profession, the importance of different skills was assessed on a scale of 1 to 5, varying from “Not important” (1) to “Very important” (5).

## Link O \* NET data

In order to calculate the required levels of training and skills for the various sectors in the circular economy, the O\*NET data must be linked per profession to occupational-by-sector data. For this we follow a procedure consisting of two steps. In the first step, we link the O\*NET data on professional characteristics to data on the professional structure of sectors of the Bureau of Labor Statistics. Because the O\*NET classification is more detailed, professions were aggregated to the 6-digit SOC level, resulting in a database of 822 occupations for 328 NAICS industries. In our calculations we use the numbers of a specific profession within a sector to estimate weighted averages of the required knowledge and skills scores for the different industries. In a second step, the knowledge and skills scores for the various NAICS industries were linked to the SBI classification of industries used in the Netherlands. In this way, the knowledge of the knowledge and skills needed within the circular economy could be considered for the Amsterdam Metropolitan Area. In terms of circular economy, we look at the 7 circular strategies that have been distinguished earlier, as well as three chains: energy

Using weighted linear regression, we test differences in the required knowledge and skills base between the CE sectors and the rest of the economy in the Amsterdam Metropolitan Area. In these analyzes, industries are weighted based on their employment level to avoid the possibility that very small industries will strongly influence the final estimates.

## Future skills

Based on the work of Frey and Osborne (2017), we compare the 7 circular economy strategies with the rest of the economy, taking into account the expected effects of future automation. Automation is defined here as task automation by means of computer-controlled equipment. Frey and Osborne (2017) calculated what the latest technological evolution is likely to mean for future employment. Using the O \* NET data and a Gauss process classifier, they have examined the future progress of the technological revolution in terms of its impact on the professional composition of the labor market and the occupations that are endangered when these technologies have their full potential. to achieve. In constructing their automation index, they argue that certain tasks requiring a high level of perception and manipulation (dexterity and skill, working in tight workspaces), creative intelligence and social intelligence (social perception and interaction skills) have a smaller chance of replacing to become by computers.



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# CIRCULAR JOBS & SKILLS

IN THE AMSTERDAM  
METROPOLITAN AREA



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