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CIRCULAR SKILLS CATCHER





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ABSTRACT

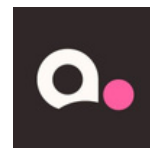
The TICHE - Training Innovation for Circularity and Holistic economies, project aims at establishing a European VET Academy on Circular Economy, based on transnational cooperation of a very experienced and complementary partnership, (including associated partners), joining Research centers, Vet centers, Universities, SMEs, clusters, Umbrella organizations, and international networks, public administrations, that will work together as an ecosystem to increase capacity building and responsiveness of the VET systems, according to a “European Education Area”.



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Objectives and structure

This second deliverable of the TICHE project aims to give a comprehensive overview on necessary skills allowing to get from the current linear system towards a circular economy.

The report is structured as follows:

- In the beginning the current status quo of circularity will be briefly analysed; on the one hand in order to understand and structure the complexity of circularity, on the other hand in order to better understand the role that lacking skills are playing as one of the key barriers: Everyone agrees that more circularity would be preferable for a broad range of reasons (environmental as well as socio-economic) – but it requires sufficient people with specific skill-sets in order to achieve it (Chapter 2).
- The next step of the work has been a mapping of existing key strategies/action plans/scenario documents at European and national level based on a literature review: This preparatory activity allowed to realize a context analysis and related set priorities with regard to achieving more circularity for different value chains as well as for specific circular strategies (Chapter 3).
- These preparatory steps are followed by setting up an analytical framework that differentiates different circular strategies and links it to necessary types of skills. The DISRUPT framework adopted for the objectives of the TICHE project is then used to systematically identify concrete skills from the ESCO skills data base (Chapter 4).
- This report concludes with preliminary conclusions on how these outcomes could be integrated in a form of “circular skill catcher”, a digital and open-source tool to visualize relevant skills and to allow e.g. providers of vocational trainings to develop focused educational services.



Obiettivi e struttura

Questo secondo deliverable del progetto TICHE mira a fornire una panoramica completa delle competenze necessarie per passare dall'attuale sistema lineare a un'economia circolare.

Il rapporto è strutturato come segue:

- All'inizio verrà analizzato brevemente lo status quo attuale della circolarità; da un lato per comprendere e strutturare la complessità della circolarità, dall'altro per capire meglio il ruolo che la mancanza di competenze sta giocando come una delle barriere principali: Tutti concordano sul fatto che una maggiore circolarità sarebbe preferibile per un'ampia gamma di ragioni (ambientali e socio-economiche) - ma richiede un numero sufficiente di persone con competenze specifiche per poterla realizzare (Capitolo 2).
- La fase successiva del lavoro è stata una mappatura delle strategie/piani d'azione/documenti di scenario esistenti a livello europeo e nazionale, basata su una revisione della letteratura: Questa attività preparatoria ha permesso di realizzare un'analisi del contesto e di stabilire le priorità relative al raggiungimento di una maggiore circolarità per le diverse catene del valore e per le specifiche strategie circolari (Capitolo 3).
- Questi passi preparatori sono seguiti dalla creazione di un quadro analitico che differenzia le diverse strategie circolari e le collega ai tipi di competenze necessarie. Il quadro DISRUPT adottato per gli obiettivi del progetto TICHE viene poi utilizzato per identificare sistematicamente le competenze concrete dalla banca dati delle competenze delle ESCO (Capitolo 4).
- Questo rapporto si conclude con conclusioni preliminari su come questi risultati potrebbero essere integrati in una forma di "acchiappa competenze circolari", uno strumento digitale e open-source per visualizzare le competenze rilevanti e consentire, ad esempio, ai fornitori di formazione professionale di sviluppare servizi educativi mirati.





Zielsetzung und Struktur

Das zweite Ziel des TICHE-Projekts ist es, einen umfassenden Überblick über die notwendigen Fähigkeiten zu geben, die es ermöglichen, vom derzeitigen linearen System zu einer Kreislaufwirtschaft zu gelangen.

Der Bericht ist wie folgt gegliedert:

- Zu Beginn wird der aktuelle Status Quo der Kreislaufwirtschaft kurz analysiert; einerseits, um die Komplexität der Kreislaufwirtschaft zu verstehen und zu strukturieren, andererseits, um die Rolle von fehlenden Fähigkeiten als ein zentrales Hindernis besser zu verstehen. Es besteht Einigkeit, dass eine stärkere Zirkularität der Wirtschaft aus einer Vielzahl von Gründen (sowohl ökologisch als auch sozioökonomisch) wünschenswert wäre, aber um diese zu erreichen, bedarf es einer ausreichenden Anzahl von Menschen mit spezifischen Fähigkeiten (Kapitel 2).
- Der nächste Schritt ist eine Bestandsaufnahme bestehender Schlüsselstrategien, Aktionspläne und Szenarien auf europäischer und nationaler Ebene basierend auf einer Literaturrecherche. Dies ermöglicht die Durchführung einer Kontextanalyse und die Festlegung von Prioritäten im Hinblick auf das Erreichen von mehr Kreislaufwirtschaft für verschiedene Wertschöpfungsketten sowie für spezifische Kreislaufstrategien (Kapitel 3).
- Auf diese vorbereitenden Schritte folgt die Erstellung eines analytischen Rahmens, der verschiedene Kreislaufstrategien unterscheidet und sie mit den erforderlichen Kompetenztypen verknüpft. Der DISRUPT-Rahmen wird im TICHE-Projekt verwendet, um systematisch konkrete Kompetenzen aus der ESCO-Kompetenzdatenbank zu identifizieren (Kapitel 4).
- Dieser Bericht schließt mit vorläufigen Schlussfolgerungen darüber, wie die Ergebnisse in Form eines "Circular Skill Catchers" integriert werden könnten, einem digitalen Open-Source-Tool zur Visualisierung relevanter Fähigkeiten, das es z.B. Anbietern von Berufsausbildungen ermöglicht, gezielte Bildungsangebote zu entwickeln.



Tavoitteet ja sisältö

TICHE-projektin toinen tulos pyrkii antamaan kattavan yleiskuvan taidoista, joita tarvitaan siirryttäessä nykyisestä lineaarisesta talousjärjestelmästä kohti kiertotaloutta.

Raportin rakenne on seuraava:

- Aluksi analysoitiin lyhyesti kiertotalouden nykytilannetta, jotta ymmärretään kiertotalouden monitahoisuus ja saadaan käsitys siitä, millaisen esteen puutteelliset taidot muodostavat kiertotalouden edistämiseksi. Yleisesti vallitsee konsensus siitä, että kiertotaloutta tarvitaan lisää johtuen monista eri syistä (ympäristölliset, sosiaaliset ja taloudelliset syyt), mutta on huomattava, että tämän tavoitteen saavuttamiseksi tarvitaan päteviä henkilöitä, joilla on tiettyjä ammatillisia taitoja (Kappale 2).
- Työn seuraavassa vaiheessa kartoitettiin olemassa olevia avainstrategioita/toimintasuunnitelmia/skenaarioita Euroopan tasolla ja kansallisesti kirjallisuuskatsauksen avulla. Tämä valmistelutyö mahdollisti kontekstuaalianalyysin tekemisen ja edelleen sitä koskevien tavoitteiden asettamisen liittyen kiertotalouden voimistamiseen eri arvoketjuissa sekä kiertotalousstrategioissa (Kappale 3).
- Edellä mainittujen valmistelevien vaiheiden jälkeen luotiin analyttinen viitekehys, jonka avulla eri kiertotalouden strategiat yhdistettiin vaadittaviin taitoihin. Tutkimuksessa hyödynnettiin TICHE-projektin tavoitteisiin sovellettua DISRUPT-viitekehystä, jotta voitiin systemaattisesti tunnistaa tarvittavat konkreettiset taidot ESCO-tietokannasta (Kappale 4).
- Raportti päättyy alustaviin johtopäätöksiin siitä, miten saadut tulokset voitaisiin yhdistää digitaaliseksi ja avoimeksi Circular Skill Catcher -työkaluksi havainnollistamaan kiertotaloudessa vaadittavia taitoja. Työkalun avulla esimerkiksi ammatillisen koulutuksen tarjoajat voivat kehittää tarjoamaansa kiertotalousalan koulutusta.



Objectifs et structure du rapport

Ce deuxième livrable du projet TICHE donne une vue d'ensemble des compétences nécessaires pour accompagner le déploiement d'une économie circulaire.

Le rapport est structuré comme suit :

- Dans un premier temps, la notion de circularité est brièvement analysée ; d'une part, afin d'en comprendre la complexité, d'autre part, afin de révéler le besoin d'évolution des compétences dans les parcours de vie. Tout le monde s'accorde sur le besoin d'une plus grande circularité pour des raisons environnementales et socio-économiques. Mais pour y parvenir, il faut des professionnels possédant des compétences spécifiques (chapitre 2).
- Le rapport dresse ensuite un panorama des stratégies, plans d'action et scénarios clés existants au niveau européen et national. Cette analyse du contexte permet d'indiquer des priorités connexes concernant les chaînes de valeur et stratégies circulaires spécifiques (chapitre 3).
- Ces étapes préparatoires sont suivies par la définition d'un cadre analytique qui permet de différencier les stratégies circulaires et de les relier aux compétences nécessaires. Le cadre DISRUPT, adopté pour le projet TICHE, est ensuite utilisé pour identifier systématiquement les compétences à partir de la base de données européenne ESCO (chapitre 4).
- Le rapport suggère comment ces résultats pourraient être intégrés dans une forme de "capteur de compétences circulaires", un outil numérique et open-source qui permet de visualiser les compétences et peut faciliter le développement d'offres ciblées, par les organismes de formations professionnelles notamment.

Αυτό το δεύτερο παραδοτέο του έργου TICHE στοχεύει να δώσει μια ολοκληρωμένη επισκόπηση των απαραίτητων δεξιοτήτων που επιτρέπουν τη μετάβαση από το τρέχον γραμμικό σύστημα προς μια κυκλική οικονομία.

Η έκθεση δομείται ως εξής:

- Στην αρχή εξετάζεται εν συντομία το τρέχον καθεστώς (status quo) της κυκλικότητας, αφενός για να κατανοήσουμε και να δομήσουμε την πολυπλοκότητα της κυκλικότητας, αφετέρου για να κατανοήσουμε καλύτερα τον ρόλο που παίζει η έλλειψη δεξιοτήτων ως ένα από τα βασικά εμπόδια. Ενώ η κυκλικότητα θα ήταν προτιμότερη για πολλούς λόγους, κυρίως περιβαλλοντικούς και κοινωνικοοικονομικούς, πολλοί συμφωνούν ότι απαιτεί ανθρώπους με συγκεκριμένες δεξιότητες για να επιτευχθεί (Κεφάλαιο 2).
- Το επόμενο βήμα της μελέτης ήταν η χαρτογράφηση των υφιστάμενων βασικών στρατηγικών, σχεδίων δράσης, σεναρίων σε ευρωπαϊκό και εθνικό επίπεδο βάσει βιβλιογραφικής ανασκόπησης. Αυτή η προπαρασκευαστική δραστηριότητα επέτρεψε την ανάλυση του πλαισίου και σχετικών προτεραιοτήτων όσον αφορά την επίτευξη της κυκλικότητας για διαφορετικές αλυσίδες αξίας καθώς και για συγκεκριμένες κυκλικές στρατηγικές (Κεφάλαιο 3).
- Αυτά τα προπαρασκευαστικά βήματα ακολουθούνται από τη δημιουργία ενός αναλυτικού πλαισίου που διαφοροποιεί τις κυκλικές στρατηγικές και τις συνδέει με τους απαραίτητους τύπους δεξιοτήτων. Η μεθοδολογία DISRUPT, που εγκρίθηκε για τους στόχους του έργου TICHE, χρησιμοποιείται στη συνέχεια για το συστηματικό εντοπισμό συγκεκριμένων δεξιοτήτων από τη βάση δεδομένων δεξιοτήτων ESCO (Κεφάλαιο 4).
- Αυτή η έκθεση ολοκληρώνεται με μερικά πρώτα συμπεράσματα σχετικά με τον τρόπο με τον οποίο αυτά τα αποτελέσματα θα μπορούσαν να ενσωματωθούν σε μια μορφή «κυκλικής σύλληψης δεξιοτήτων», ένα ψηφιακό και ανοιχτού κώδικα εργαλείο για την οπτικοποίηση των σχετικών δεξιοτήτων και που θα επιτρέπει ενδεικτικά τους παρόχους επαγγελματικής κατάρτισης να αναπτύξουν εστιασμένες εκπαιδευτικές υπηρεσίες.



Introduction and background

The essential idea of a Circular Economy is not fundamentally new: products and the raw materials they contain should be recovered as far as possible at the end of their use phase and brought back into circulation. This is intended to reduce the amount of waste and extraction, and replace the use of primary raw materials with recycled materials. However, this requires a fundamental transformation in production and consumption patterns – of course including the skill sets of people working on it. The following figure illustrates the stronger coordination of different stages of the value chain that lies at the core of the Circular Economy.

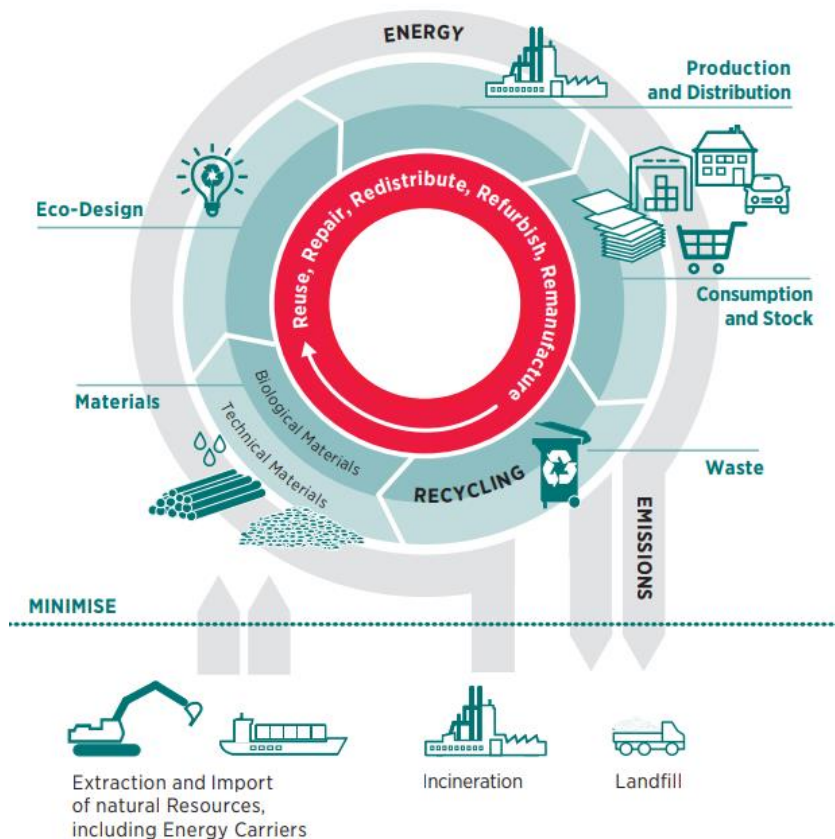


Figure 1: The Concept of Circular Economy.

Source: Wilts & Berg (2017).

- Starting from their conception, products should be designed so that they can be recycled or repaired at the end of their lifecycle. According to many stakeholders, 80% of how circular product systems turn out in the end is already decided in this early phase.

- Closely connected to this are questions of circular business models as the central adjusting screw of circular value chains: For example, how can incentives be created for durable product design if this initially reduces companies' sales because customers no longer have to replace their products as frequently (planned obsolescence)?

- A central factor here is also the design of logistics or "reverse logistics" structures: For products to truly be recycled in a meaningful way, they must be able to be fed into the right recycling process. At the same time, the


recycled secondary raw materials must also return to the companies if they are to use them eventually.

The Circular Economy is often considered to be synonymous with classic waste management, but this does not do justice to its comprehensive, holistic approach. Evidently, closing material cycles requires the optimised collection, dismantling, and recycling of waste streams so that the economy's raw material needs can increasingly be met by recycled materials. Over the last decades, the amount of waste has persistently risen and will continue to do so if no further action is taken. Today the linear economy is already creating challenges for waste disposal. One must take into consideration that all ecosystems are affected by waste creation and disposal. Plastic waste, for instance, is already a major concern for oceans and maritime life, indicating that today's systems have significant problems of proper disposal and waste management. The future challenge will therefore be to find new approaches to prevent resource use and subsequent waste generation from becoming a problem for different ecosystems, which can only be achieved by implementing Circular Economy systems.

The Circular Economy defines itself fundamentally as a counter-design to the current linear economy, which is characterised by a "take-make-dispose" approach whereby raw materials and other natural resources are taken from ecological systems, often used for a shockingly short time, and end up as waste. In such a linear economy, waste management therefore has the primary task of reliably disposing of waste so that it no longer threatens human health or the environment. Central approaches with regard to waste disposal are waste incineration or regulated landfilling. These are technological end-of-pipe solutions which enable the continued generation of waste without the prospect of maritime waste, which have shown the limits of the current system and solutions. The discussion about the Circular Economy is still in an early phase. Furthermore, the term is still often interpreted very inconsistently in different contexts. A study by Kirchherr et al. (2017) identified more than 110 different definitions in the scientific literature alone, each of which differ significantly in various aspects:

- There are clear differences with regard to the scope of what is to be understood as Circular Economy. Figure 2 shows the 9R framework according to Potting et al., which represents the range of possible activities from waste incineration to conceptual waste prevention. Many definitions still focus strongly on the material level (R8 + R9).
- In addition to Figure 1, there are various representations that differentiate the overall cycle of material flows between a technical and a bio-based cycle (for instance the "butterfly diagram"): The main consideration here is the difference between reducing the consumption of primary non-renewable resources (efficiency) or making the use of bio-based resources sustainable (consistency).

- The question regarding the geographic level at which material cycles are to be closed has not yet been clarified: Should the closure of material cycles be achieved on the level of circular cities, circular economies, or circularity on a global level? This has very different

Circular economy		Strategies	
 Increasing circularity	Smarter product use and manufacture	R0 Refuse	Make product redundant by abandoning its function or by offering the same function with a radically different product
		R1 Rethink	Make product use more intensive (e.g. by sharing product)
		R2 Reduce	Increase efficiency in product manufacture or use by consuming fewer natural resources and materials
	Extend lifespan of product and its parts	R3 Reuse	Reuse by another consumer of discarded product which is still in good condition and fulfils its original function
		R4 Repair	Repair and maintenance of defective product so it can be used with its original function
		R5 Refurbish	Restore an old product and bring it up to date
		R6 Remanufacture	Use parts of discarded product in a new product with the same function
		R7 Repurpose	Use discarded product or its parts in a new product with a different function
	Useful application of materials	R8 Recycle	Process materials to obtain the same (high grade) or lower (low grade) quality
R9 Recover		Incineration of material with energy recovery	
Linear economy			

implications, for instance for the import/export of waste.

Figure 2: The 9R Framework. Source: Potting et al. (2017).

Against the background of such diverging understandings, the International Organization for Standardization started a process to come up with a definition supported by a broad range of stakeholders (ISO/ TC 323). For the purpose of this report, the key aspect of circularity is the contribution to absolute resource conservation by systemic changes: the Circular Economy should not be considered simply as an improvement of the current linear system it aims to replace, thus also completely new skill sets are required.

The linear economy as a dead end

The linear economy has accompanied our economic boom and brought us prosperity. However, as its environmental and social effects have now been appraised substantially, CE scholars advocate that it is the only way to move forward, for the following reasons:

- From an environmental perspective, it is clear that the resource consumption associated with this model is far beyond all limits of sustainability. In 2020, for the first time, humanity consumed a total of over 100 billion tonnes of natural resources, and the use of resources such as biomass, ores or minerals has increased fivefold since the 1950s. According to estimates by the International Resource Panel, resource production and consumption is responsible for 50% of all greenhouse gas (GHG) emissions and over 90% of global species loss (IRP, 2019; Ellen MacArthur Foundation, 2021). This illustrates how the goal of climate neutrality can only be achieved through the framework of a Circular Economy (see Figure 2). Current calculations show that the Circular Economy could enable a third of the necessary emission reductions in the industry by 2050. The energy transition is necessary, but must address and include the equally challenging resource transition.

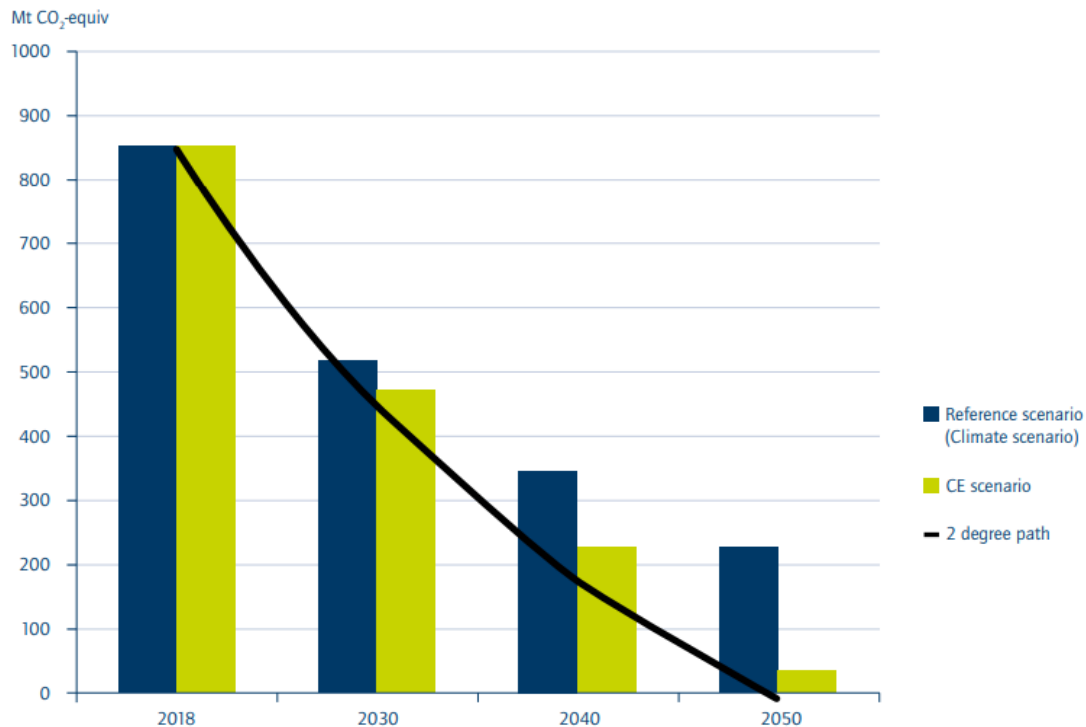


Figure 3: GHG emissions in the ambitious climate policy reference scenario and a Circular Economy scenario in Germany. Source: CEID (2021).

- There is also an economic necessity for the transformation to a Circular Economy: Europe will only be able to secure its role as an economic and industrial powerhouse if the transition to a Circular Economy is accelerated. Compared to other powers, Europe is dependent on imports of most critical raw materials, which poses increasing risks to the security of supply

chains. In addition, many companies are recognising that the comparatively simple linear production patterns can probably be established or copied more cheaply in other parts of the world in the future. The decline of the EU photovoltaic industry due to cheaper imports from Asia is an example of such a development. Against this background, the Circular Economy represents a strategic opportunity to develop global innovation leadership that could secure competitiveness and millions of jobs in Europe.

There is an urgent need to speed up this process – Europe still depends on raw material imports from Russia and China that could have already been replaced by secondary materials from recycling. Materials in this category include palladium, platinum, titanium and vanadium, which are especially important for the automobile and aerospace industry (Gehrke, T. 2022). The following chapter shows that despite the increased awareness of the need to become circular, our patterns of production and consumption are still predominantly linear.

How far along are the EU and its Member States?

In order to allow consistent monitoring of progress towards a Circular Economy across Europe, the European Commission has developed a framework of 10 indicators, covering different aspects from waste management to innovation. In fact, all indicators show that the Circular Economy is not yet a broadly established concept but is still in its infancy. The worrying figures that follow demonstrate the need to go beyond pilot projects. Figure 4 shows the development of municipal waste per capita in EU-27 countries. It measures the amount of waste collected directly by local authorities and which is disposed of in the waste management system. After a continuous decrease until 2014 the amount began to rise again in 2015.

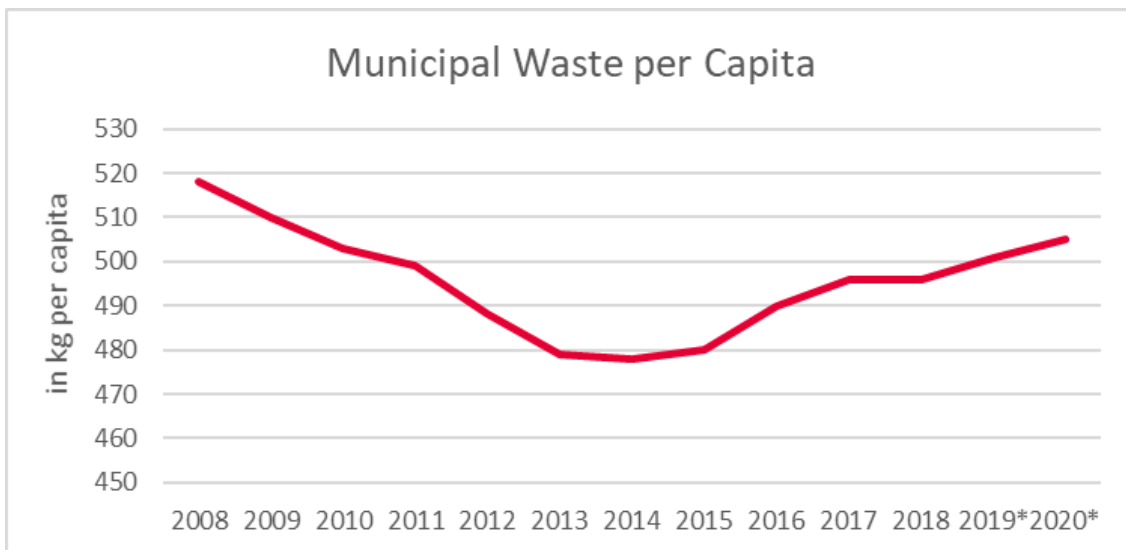


Figure 4: Municipal waste per capita in EU-27 countries. Source: Eurostat (2022a).

*The amounts for 2019 and 2020 are estimated values.

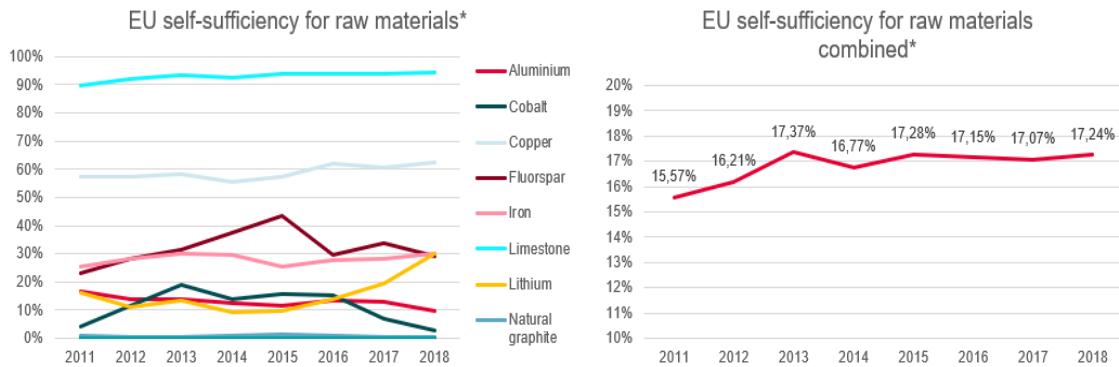


Figure 5: EU self-sufficiency for raw materials. Source: Eurostat (2022b).

*The combined figure also includes borate, dysprosium, europium, molybdenum, neodymium, tantalum and yttrium, which are all at a constant level of 0%.

Figure 5 shows the self-sufficiency indicator, which measures how much the EU is independent from the rest of the world for several raw materials. It has been calculated based on domestic production, exports and imports.¹ The detailed indicators for specific raw materials show that the EU is more self-sufficient for certain raw materials (e.g. limestone) than for others (e.g. natural graphite). For most raw materials, the level of self-sufficiency remains relatively constant over time. There are however a few exceptions. Fluorspar and cobalt peaked in 2015/2016, but have decreased since then. The indicator for lithium shows an increasing trend since 2016. However, due to the increasing demand for certain materials, even if the recycling rate were 100%, the EU would still be dependent on importing different raw materials.

¹ The detailed formula can be found at Eurostat (2022b).

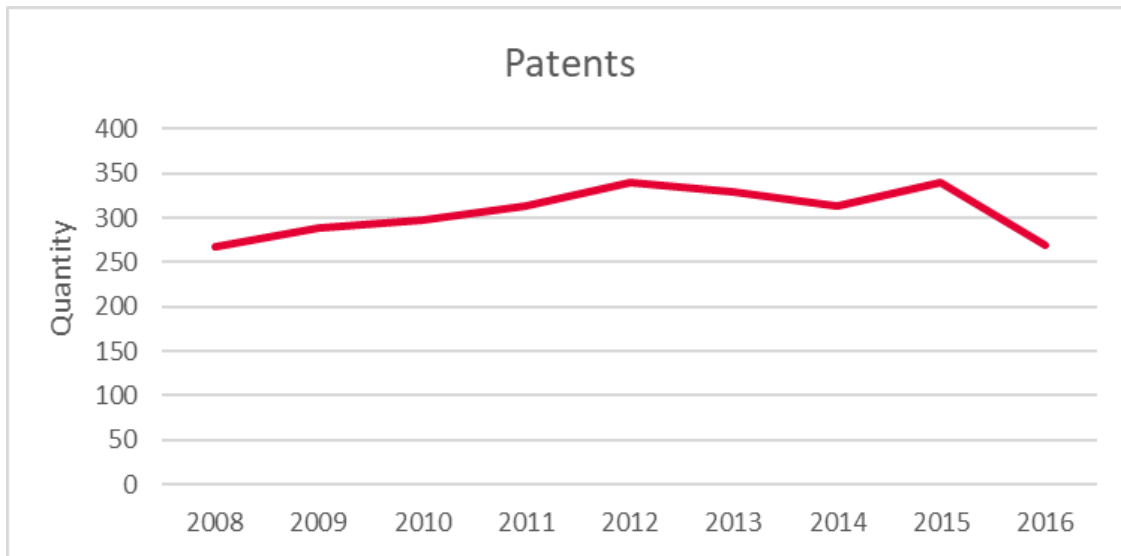


Figure 6: Number of patents related to recycling and secondary raw materials, total number in EU-27, Source: Eurostat (2021a).

Another interesting indicator to look at is the number of patents related to recycling and secondary raw materials. The indicator is based on the definition of recycling and secondary raw materials in accordance with the relevant codes in the Cooperative Patent Classification (CPC). Multiple counting is prevented by counting the number of patent families, which include all documents relevant to a distinct invention. Between 2008 and 2012 the amount increased steadily, but since then the number decreased almost to the 2008 level.

These indicators for the EU as a whole evidently do not reflect the often very different developments in specific Member States. In order to measure the genuine circularity of different national economies, Eurostat has developed the Circular Material Use Rate (CMUR), which measures the share of material recycled in overall material use. It also considers imports and exports of waste destined for recycling. The overall rate for all EU-27 countries is 12.8%, with a significant discrepancy among the countries:

The Netherlands has the highest rate at 30.9%, and Romania has the lowest at only 1.3%. It is interesting to note that usual model pupils such as the Nordics and Austria fare worse than average.

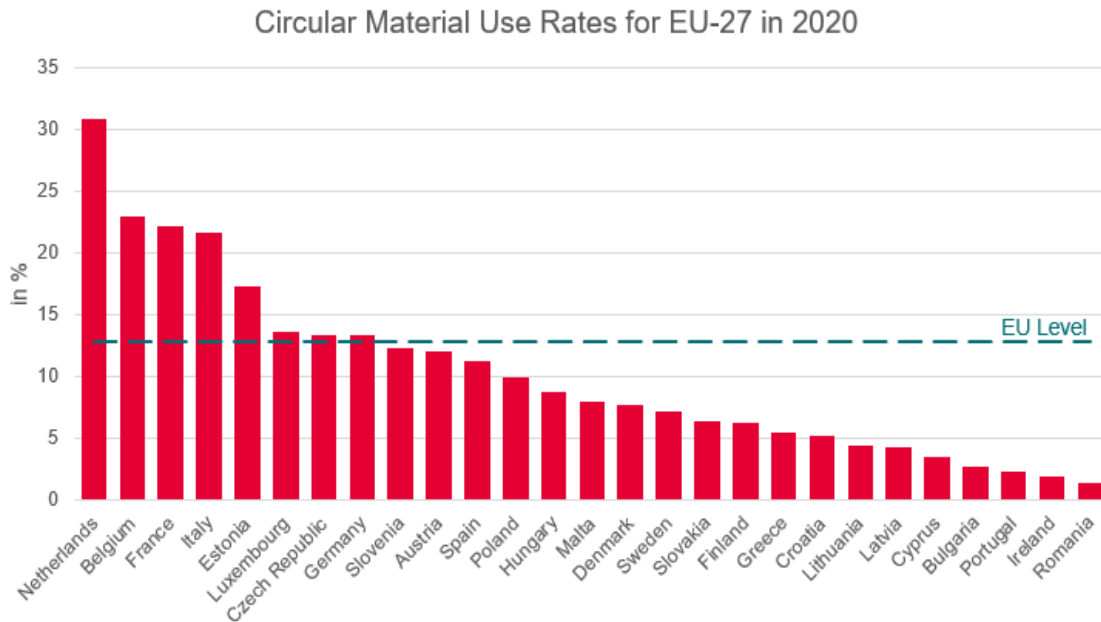


Figure 7: Circular Material Use Rate (CMUR) for each EU-27 country in 2020. Source: Eurostat (2021b).

Overall, it becomes clear that there is still room for and a need for improvement in terms of the reuse of materials in Europe. The rising amount of waste and stagnating self-sufficiency rates underline the urgency to improve respective measures. The sinking number of patents also indicates a need for action.

Similar developments can be observed with regard to employment effects of the circular economy: Positive but with regard to the challenges insufficient speed of progress. The following figure shows the current number of jobs in the circular economy by EU27 Member State². Between 2014 and 2018, the number of jobs in the circular economy in the EU27 increased from 2.9 million to 3.4 million, an increase of ~17%. For comparison, employment growth in the manufacturing sector over the same period was ~9%. However, the trend is not uniform across the EU27. Whilst growth in circular economy employment has almost doubled (from a low base) in the Czech Republic over this time period, it has declined by 6% in Austria.

² <https://wrap.org.uk/sites/default/files/2021-12/Delivering%20climate%20ambition%20through%20a%20more%20circular%20economy.pdf>

According to an analysis by WRAP (2021) here is a positive correlation between the level of gross value added (GVA) from circular economy business models and the overall level of GVA within an economy,

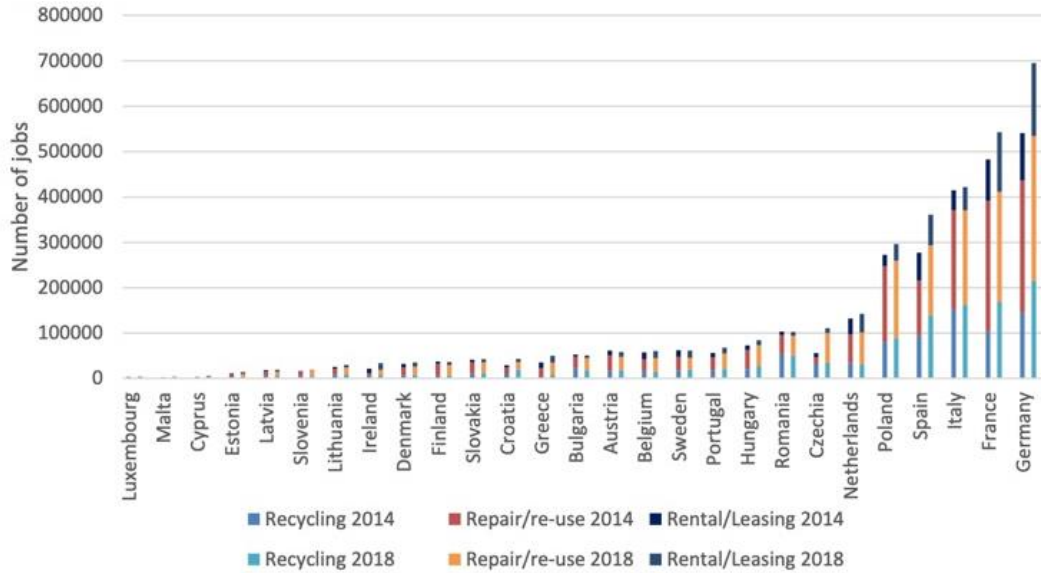


Figure 8: Employment in the Circular Economy for the EU27, 2014 and 2018 (Eurostat)

suggesting that larger economies have, inter alia, a larger contribution from the circular economy. However, there is no relationship between the size of the economy and the percentage contribution from the circular economy. This measure is of interest as it shows that there is no clear distinction between northern, southern, eastern or western Europe, and suggests that variables other than the size of the economy can affect the take-up of circular economy in different countries. There is therefore potential for growth regardless of the overall size of an economy.

Impulses for circular employment

Against the background of this massive gap between the environmental and economic potentials of a Circular Economy on the one hand, and the lacking pace of progress towards really exploiting them on the other hand, lies the question of the necessary impulses needed.

The European Commission in particular has become a decisive driving force in recent years and has presented an extremely useful roadmap in the form of the Circular Economy Action Plan (European Commission, 2020) which aims at transforming the European Union in the direction of circular value creation. The specifically quantified goals include not only halving the volume of residual waste by 2030 but also doubling the share of recycled materials in the industry and increasing gross value added by 80 billion euros per year.

In addition to environmental and climate policy, the Action Plan focuses on the competitiveness and innovative capacity of European industry (European Commission, 2020). A key promise by the European Commission is

especially the creation 700,000 new jobs – raising the key question for this report what kind of skill-sets would be required to achieve this goal.

The transition to the circular economy will crucially depend on the skills available, as well as shape the skills that are needed in the labour market³. Jobs in the circular economy are likely to involve a combination of more traditional skills, such as manual ones, and more novel circular skills, such as those in modular design and the analysis of material compositions. Soft skills for collaborating across sectors and service-related skills will be just as important as hard skills for programming, operating and repairing equipment. Skilling for the circular economy thus requires both practical and academic education pathways, across all fields of knowledge.

According to the analysis by Circle Economy, the current education system, particularly in countries in the Global North, is linear: people are largely schooled for one profession and task divisions between job roles can be rigidly defined. The authors identify a lacking culture of life-long learning and continuous development that is vital in transitioning economies, where new innovations are constantly being developed, broader skill sets are required, and roles are more diverse. Where life-long learning is being made more accessible via online platforms, work is still needed to ensure these programmes are high quality and accessible to people of different levels of education. We are living and working longer in an age of rapid digitalization, increasing the need and opportunity for retraining across our working lives. Labour is viewed as cost by employers, not talent to be developed.

There is a lack of frameworks that support circular talent development. Re- and upskilling is not always seen as cost-effective for employers, with practically-skilled and older workers generally receiving the fewest opportunities for professional development. This creates social inequality and low wages particularly for practically-skilled workers, even in times of economic growth. However, opportunities to capitalise on the advances of technologies and business models are appearing as employers are seeing the ever increasing need to place priority on the skills gaps emerging in their organisations and invest in training. Despite being a hotly debated topic on national and international agendas, it is often unclear about what constitutes different skills or how they should be taught. There is collective uncertainty about the skills that will be needed in the future circular economy and the potential for job loss as sectors transition. Without a proper understanding of emerging and future skills needs, industry and government are hesitant to invest in their development. Skills gaps are emerging in sectors that are innovating at high pace to become more circular as a result, for example in the digital tracking of building materials and components.

According to the analysis by Circle Economy circular knowledge is limited and not being shared. Understanding of the benefits of the circular economy is limited and where present, it is largely concentrated in research institutions and frontrunner businesses and cities. Awareness of the circular economy is not being widely promoted amongst the public or translated into curriculum and practice in schools, universities or professional training programmes. This means that important skills like those needed to connect and co-create with others, assess systems implications of design decisions or those needed to repair appliances are not being taught or encouraged to people in education or training. As a result, education cannot adequately prepare students for the demands of the future and the changing world of work, nor does it equip people to make circular choices as consumers. Although efforts

³ https://assets.website-files.com/5d26d80e8836af2d12ed1269/5e6897d4fe8092a5a678a16e_202003010%20-%20J%26S%20in%20the%20circular%20economy%20report%20-%20297x210.pdf

are being made towards creating more bottom-up and peer-to-peer approaches to life-long learning in the context of the circular economy.

Against this background the Circular Jobs Initiative defines a need to develop a joint understanding of the skills needed for achieving the circular economy: “To do this, we need to unite fragmented narratives and create a common language for new and existing skills that are needed for jobs that contribute to the circular economy, supported by definitions, metrics and standards. This will help to inform the development of practical and accessible tools for mapping skills needs across sectors and regions, which can be used to understand the impact of transition pathways on skills demand and labour distribution. From here, we can develop a better understanding of which training programmes are needed, and the impact of policy levers on skills demand and supply.”

Although those who present the CE as a new business model put new job opportunities at centre stage, relatively little is actually known especially about the quality of employment in the CE⁴. Most studies that have addressed CE employment focus either on estimating how many workers are active in the CE (e. or on calculating the net employment effect of the development of the CE, recognizing that the development of the CE may also crowd out or replace traditional industries. This body of literature has found that CE employment in Western nations typically accounts for between 0.5% and 5% of national employment⁵. However, these figures might underestimate the true size of the CE because most studies focus on the ‘green’ component of the CE only and neglect the non-green jobs that enable the development of the CE.

Burger et al (2018) highlight that despite the growing number of studies assessing the size, growth, and potential of the CE in terms of employment, there is little knowledge of the type of workforce the CE requires. In other words, it is unclear what types of employees will be necessary to accommodate the (potential) future growth of the CE. However, such knowledge is essential to ensure that future labour supply matches labour demand. In this regard, a mismatch between the skills and abilities necessary in the CE and the average skills of workers in the economy at large would signify a need to interest young people in careers in CE-related occupations and to improve and tailor education programs to accommodate future labour demand. As outlined in Chapter 2, it is of course important to recognize that the CE is a heterogeneous and composite sector and that different subsectors of the CE have different knowledge bases in terms of the skills, education and experience they require, given that tasks vary across these sectors.

Literature review: Necessary skills for the circular economy

Against the background of these uncertainties and in order to develop an analytic framework for necessary skills in the circular economy, a literature review has been conducted in order to understand

⁴ <https://www.sciencedirect.com/science/article/abs/pii/S0048733318302026>

⁵ Horbach et al., 2015

the current state of the art, specific challenges and how to address them and of course in order to build upon previous work and existing data sources.

The following list shows the reports and papers that have been analysed for this task. It includes research reports as well as academic papers; some of them with a very broad view on the topic, some of them rather focused, e.g. on impacts of digitalization in a circular economy.

- Circle Economy/ Goldschmeding: Jobs and Skills in the Circular Economy
- UNESCO-UNEVOC: Skills for the circular economy
- Willeghems & Bachus (2018). Employment impact of the transition to a circular economy: literature study.
- Guyet-Phung (2019). Implications of the circular economy and digital transition on skills and green jobs in the plastics industry
- Cambridge Econometrics, Trinomics & ICF (2008). Impacts of circular economy policies on the labour market. European Commission.
- Burger et al (2018). The heterogeneous skill-base of circular economy employment.

The following chapters summarize key outcomes of these reports before Chapter 5 draws conclusions how to integrate this in the development of a “skill catcher” for the circular economy.

Jobs & Skills in the Circular Economy - State of Play and Future Pathways

This report by Circle Economy and Goldschwing Foundation focusses on job creation opportunities in the circular economy, taking into account necessary skills as well as aspects of quality of work. The report was developed on the basis of extensive literature review and consultation with over 50 cross-sector organisations. These interviews focused on one of four key issue areas for the Circular Jobs Initiative: skilling the workforce for the circular economy; the quality of work in the circular economy; the inclusivity of the circular labour market; and technology’s role in work in the circular economy.

Following these interviews, all stakeholders were invited to participate in one of a series of four roundtable discussions. The discussions explored in further depth the opportunities and challenges related to each issue, alongside the related roles and responsibilities and the immediate steps that should be taken to achieve positive outcomes for workers in the circular economy. The report uses the so-called “DISRUPT” framework of circular economy that was also chosen for the empirical part of this report, see Chapter 4.

Skills for the circular economy⁶

This report includes key outcomes of the UNESCO World Conference on Education for Sustainable Development that was held from 17 to 19 May 2021. During this event, UNESCO-UNEVOC hosted sessions on Green and Circular Economies and ESD in TVET. These sessions explored ways to restructure business processes in favour of the circular economy, strategies for education, training and industry to shift mindsets and nurture lifelong learning, and tools and approaches to mainstream ESD and climate education in TVET. The circular economy was here introduced as a concept already making waves in sustainability policy and practice, as evidenced by the global experiences shared at the conference.

Experts like Walter Stahel, Founder and Director of the Product-Life Institute, Switzerland, reinforced the importance of caring for natural and human assets and enabling a circular economy through education and training. He elaborated on several key concepts in his writings, 'the era of R' (re-use, repair, remanufacture) and 'the era of D (de-construct, de-coat, de-laminate and so on)', the former focusing on extending the service life of objects and the latter focusing on using innovative modern techniques to recover materials for re-use. The challenge of instigating these eras will involve policies which promote relevant education and training and encourage innovation. Based on the discussions during the conference, the authors highlight the increasing importance of the circular economy that from their point of view will have a significant impact on the shape of jobs and competencies. New points of emphasis will include 'broad skills' (also called transversal skills) such as digital and green literacy and problem solving, while also building 'deep skills' more related to specific functionalities or disciplines. Non-repetitive, circular jobs will emphasize skills such as product repair and maintenance or innovating the product design process to improve longevity. TVET has a critical role to play in the evolution of circular approaches to extend the service life of goods and close the loop. First and foremost, it must meet the demand for higher technical skills and provide crucial support for lifelong learning through upskilling as well as continuous and in-work learning. In addition, TVET needs to equip young people with the relevant entrepreneurial skills and STEM (science, technology, engineering and mathematics) competencies for green jobs in emerging sectors.

With regard to the objectives of TICHE, also UNESCO-UNEVOC recognizes several challenges to reaching the SDGs and climate-related plans of action:

- Lack of awareness about sustainability
- Low capacity at the levels of decision making, teaching and implementation in practice
- Shortages in skills resulting in unmet labour market demands

⁶ <https://unevoc.unesco.org/home/Skills+for+the+circular+economy>

- Unsustainable patterns of consumption and production
- Outdated competencies and qualifications
- Lack of recognition and assessment mechanisms for skills acquired through non-formal and informal learning
- Lack of targeted engagement of key actors including youth, community and enterprises

Gwen Willeghems, Kris Bachus (2018): Employment impact of the transition to a circular economy: literature study

Framed within the Flemish policy research centre Circular Economy, this research paper was the first output of a specific research line that studies employment and actor analysis for the circular economy. 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'.

Carola Guyot Phung: Implications of the circular economy and digital transition on skills and green jobs in the plastics industry⁷

This paper specifically focusses on the European plastics industry on its way towards a circular economy. This industry that 1,5 million people is particularly impacted by the rise of the circular economy and digital transition: in addition to changing businesses' economic models, these developments also bring with them structural and workforce changes that require taking a fresh look at traditional roles and their associated skill sets. Jobs are changing in shape and content, from design to production, all the way to waste recovery. The arrival of cobotization (human-robot collaboration) and blockchain are part of this movement. Businesses and training bodies are adapting their support strategies in response to this phenomenon and growing skills hybridization.

According to the authors, the impacts of digital transition are massive and felt across all sectors of the economy. It is thought that millions of jobs worldwide will be lost to machines. In 2022, the share of total work hours performed by humans will fall to 58%, with machines performing the other 42%, up from 29% in 2018. New roles will emerge, more suited to the new division of labor between humans, machines and algorithms: specialists in machine learning and artificial intelligence, big data, experts in automation, data security, customer experience and human-machine interaction, robotics engineers and blockchain specialists. In manufacturing, machines generate vast datasets that are collected, exploited and prepared by engineers for operators. For example, extruders and machines for printing, gluing and spooling plastics can operate continuously while simultaneously generating several gigabytes of data daily, data that will be used for monitoring and predictive maintenance. This will in turn lead to hybridization of skills and roles. Digital skills will find their way into roles that were originally non-scientific (marketing, design, etc.), whereas other technical roles will require additional skills of a more cross-cutting nature (social, creative, etc.). These mutations, combined with rapid changes of economic models, destabilize skills bases. Businesses can then either adapt via learning and knowledge engineering strategies, or by calling in outside resources via recruiting new permanent staff, temporary staff or freelancers. Such changes demand matched training offers, with some of the skill sets to acquire being spread across very different industries. In the future, advanced engineering schools will embed

⁷ [Impacts of digital transition on skills](#)

digital advances within their syllabuses. Transformations impacting employment types and how they are organized will lead to more frequent changes of job and task. Training methods will also evolve toward a peer-to-peer model, via platforms or augmented reality, allowing people to acquire the skills they need as and when they need them. However, not all employees within an organization will necessarily be treated equally, if only because some will be digital natives and others not. People occupying the most-impacted posts will have the greatest need for upskilling, but they risk being disadvantaged in favor of those occupying roles judged strategically important. The following figure summarizes key outcomes with regard to future developments in different sectors.

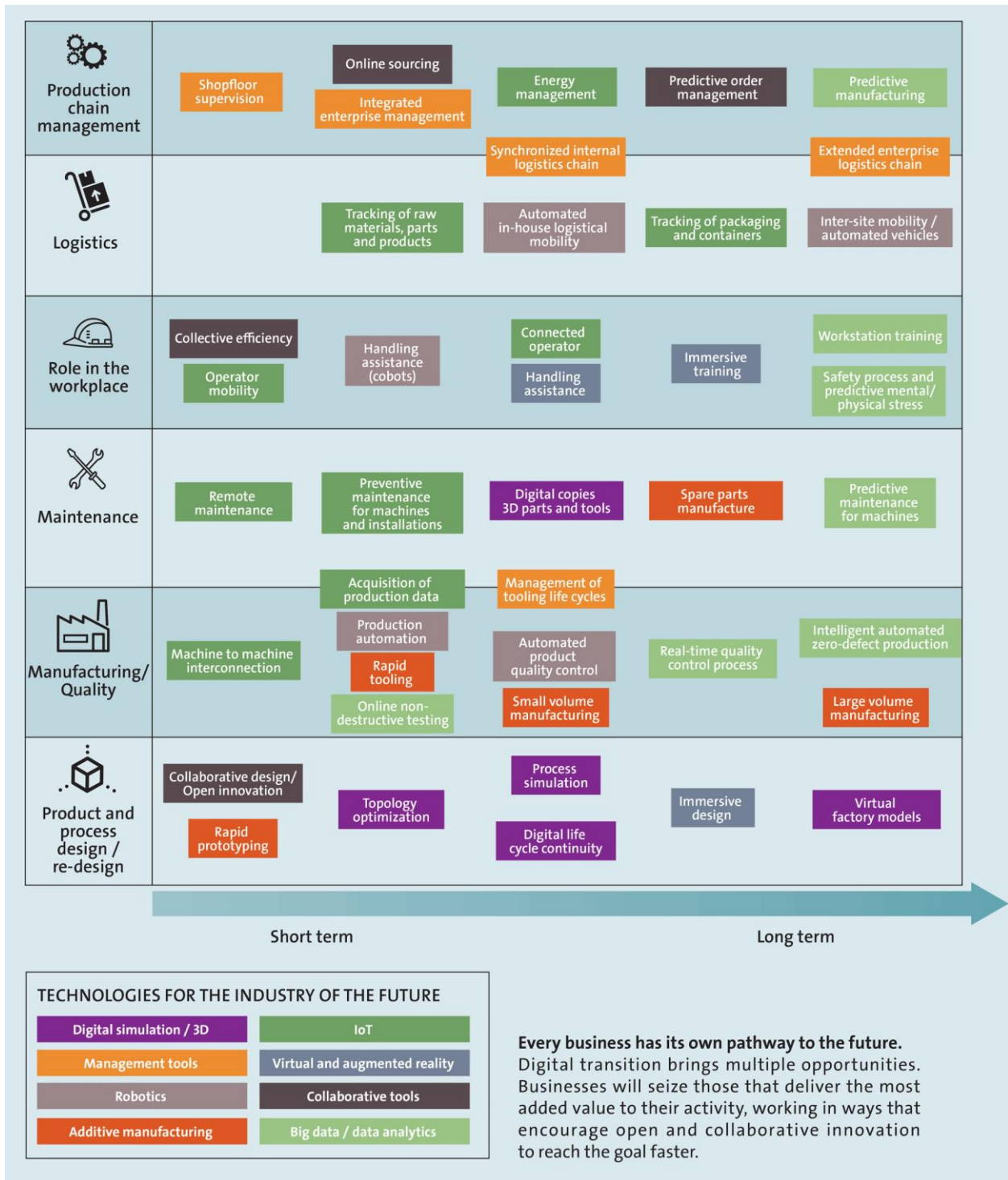


Figure 9: Classification of required skill set changes in a digitalized plastics economy

Source: <https://journals.openedition.org/factsreports/5498>

Cambridge Econometrics, Trinomics & ICF (2008). Impacts of circular economy policies on the labour market. European Commission⁸

This report provides detailed answers to the question how a transition to a more circular economy would affect jobs and skills demand in Europe. The study looked at trends of circular economy activities across different sectors and quantified these activities as modelling inputs to provide employment changes for different sectors. Furthermore, the analysis provides estimates of the occupational shifts and skills requirements that a shift to a more circular economy could entail. The aim of this report was to develop an understanding of how a transition towards a more circular and resource efficient economy in Europe will affect labour markets across the Member States. At the moment this analysis seems to be the most comprehensive quantification of the EU jobs impacts from the circular economy.

By using a fully integrated energy-environment-economy model (E3ME), the analysis considers both direct job losses and job creations that result from a shift to a more circular economy. It also captures indirect, induced and rebound impacts from interactions between sectors, Member States, and between economic, environment, material, energy and labour market indicators. The findings suggest that the EU is on the right track by making the circular economy a policy priority as circular economy policies will contribute to reducing negative environmental impacts, while simultaneously contributing to higher employment levels. By moving towards a more circular economy, GDP in the EU increases by almost 0.5% by 2030 compared to the baseline case. The net increase in jobs is approximately 700,000 compared to the baseline through additional labour demand from recycling plants, repair services and rebounds in consumer demand from savings generated through collaborative actions. Although the magnitude of job creation is driven by assumption of the rate of circular economy uptake in the scenarios, the analysis confirms that it is possible to become more resource efficient and increase employment at the same time – as shown in the following figure.

⁸ https://circulareconomy.europa.eu/platform/sites/default/files/ec_2018_-_impacts_of_circular_economy_policies_on_the_labour_market.pdf

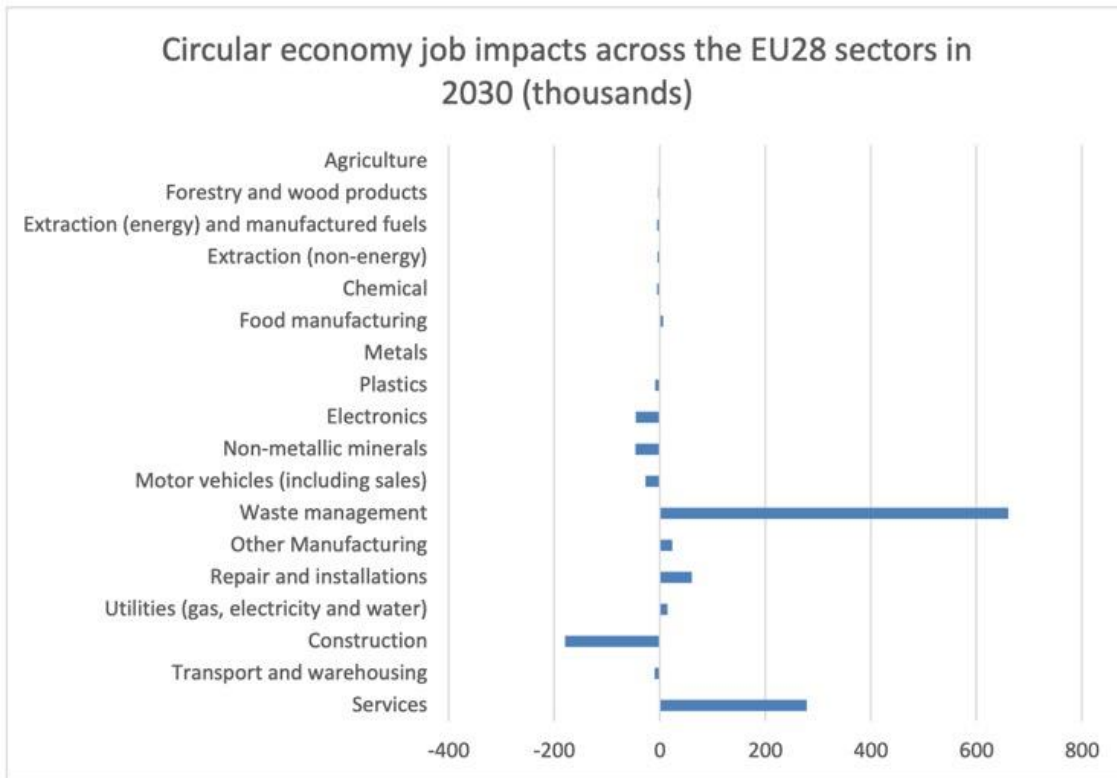


Figure 10: Circular economy job impacts across the EU28 sectors in 2030 (thousands)

Source: https://circulareconomy.europa.eu/platform/sites/default/files/ec_2018_-_impacts_of_circular_economy_policies_on_the_labour_market.pdf

While the net impacts on EU employment are positive, the authors conclude that sectoral composition of employment will change. Sectors that produce and process raw materials will decline in size while the recycling and repair sectors will experience additional growth. The report also identified other sectors that will potentially benefit from transition toward a circular economy, including services sectors and electricity. Sectors that could lose out include those that produce durable goods such as electronics, machinery, cars and accommodation. Construction sector employment is expected to fall from productivity gains as a result of new building techniques. The study’s scope excludes energy efficiency improvement to existing properties which could well compensate this loss. Among Member States, the GDP and employment results are positive but are generally higher in the Central and Eastern European countries, primarily due to larger reductions in oil imports in these countries as a result of more circular economy activities in the motor vehicles sector. Countries in western Europe are more affected by a decline in production of electronics and cars. In Eastern Europe, these durable goods are mostly imported and so the reduction in demand improves the trade balance and GDP. In terms of skills needs across the various sectors and occupations, the additional impacts of circular economy take-up are relatively small-scale in comparison with other drivers of change, such as the impact of technological change on jobs and the shift to high-skilled jobs in some sectors. This finding suggests

that take-up of circular economy activities does not in itself have a transformative effect on labour markets with regards to skills needs, even under the ambitious scenario; the jobs and skills implications of the circular economy should be seen in this inter-connected context. The general trend is towards increased demand for cross-cutting competences, such as problem solving and communications. Transition to the circular economy therefore provides evidence of the importance of transversal skills, not least because jobs will evolve and workers will need to be adaptable. The following table shows the essential skills/competences and knowledge associated with the most relevant occupational unit groups based on the ESCO mapping for jobs in the waste management sector. There is a relatively high

Table 6.3 Skills, competences and knowledge for refuse and recycling workers

	Refuse collector	Recycling worker	Sorter labourer
Essential skills and competences	<ul style="list-style-type: none"> • assess waste type • collect domestic waste • collect industrial waste • maintain refuse collection equipment • maintain waste collection records • manage waste 	<ul style="list-style-type: none"> • assess waste type • collect broken appliances • dismantle broken appliances • dispose waste • ensure compliance with waste legislative regulations • handle chemical cleaning agents • manage waste • operate recycling processing equipment • troubleshoot • use personal protection equipment 	<ul style="list-style-type: none"> • assess waste type • communicate with waste collectors • dispose waste • handle chemical cleaning agents • operate recycling processing equipment • sort waste • store sorted waste
Essential Knowledge	<ul style="list-style-type: none"> • health, safety and hygiene legislation • waste and scrap products • waste management 	<ul style="list-style-type: none"> • health, safety and hygiene legislation • waste and scrap products • waste management 	<ul style="list-style-type: none"> • health, safety and hygiene legislation • waste and scrap products • waste management

Source: ESCO v1.0.2

degree of commonality in skills and knowledge requirements across the different job roles.

Figure 11: Skills, competencies and knowledge for refuse and recycling workers

Source. https://circulareconomy.europa.eu/platform/sites/default/files/ec_2018_-_impacts_of_circular_economy_policies_on_the_labour_market.pdf

The report also highlights that there are large uncertainties surrounding the future labour intensities in the waste sector due to increased automation, product material enhancement (to ease recycling) and technology. The indicated employment results for the waste sector could be overestimates if there was a sustained drive to increase mechanisation in the sector.

The heterogeneous skill-base of circular economy employment⁹

This paper examines the opportunities and risks of employment, skills and education that are related to a CE in the United States. Combining occupational skills and education data with a newly introduced definition of CE employment, the authors compare circular- and non-circular-oriented occupations in terms of skills and abilities. Building on the paper by Consoli et al. (2016) and looking at all occupations within a broad range of CE-related industries, the authors detect and address heterogeneity in job requirements within the CE.

They distinguish core activities within CE employment – focusing on renewable energy, repair, re-use of materials and the sharing economy – from enabling activities, which are focused on management, design, and ICT-applicability of the CE. While core CE-activities generally require more manual and technological skills, enabling activities, in contrast, require more complex cognitive skills. Neither core nor enabling CE sectors, however, are entirely cohesive in terms of skill requirements. Part of the education and skills demand is identifiably driven by ‘circularity’, particularly with regard to technical skills for the core of the CE.

Employment and the circular economy Job creation in a more resource efficient Britain¹⁰

This report by the UK Waste and Resource Action Programme (WRAP) focused on the employment effects of the circular economy in Britain that faces huge economic challenges in its use of labour and scarce natural resources. Although unemployment is now falling, the risk of being out of work is higher in some regions and for some types of occupations. The study focuses on impacts on employment and aims to identify the scope for the growth of the circular economy to offer new jobs. Britain is already experiencing significant labour market challenges, such as persistent high unemployment in some regions and declining employment in mid-level occupations. The UK labour market exhibits significant regional and occupational mismatch, meaning that available employment opportunities are often not well aligned, either with where the unemployed live, or with the experience they have from their previous occupations. Labour market mismatches are thought to account for around three percentage points of the unemployment rate and are likely to have played a significant role in the rise in unemployment since the start of the financial crisis. The study aims to go beyond a simple quantification of the number of jobs that could be created in an expanded circular economy. Although such calculations are useful to give a sense of the employment needs of a growing sector, they are not

⁹ [Research Policy Volume 48, Issue 1](#), February 2019, Pages 248-261

¹⁰ <https://wrap.org.uk/sites/default/files/2021-02/WRAP-Employment-and-the-circular-economy-summary.pdf>

informative about the opportunity for improving the national labour market situation. They tend to ignore how the growth will interact with other parts of the economy, ie whether new jobs will be genuinely additional and reduce unemployment, or whether they will simply displace existing ones. Instead, the study places the growth of circular economy employment in the broader context of the British labour market. The authors considered the regional and occupational patterns of employment in recycling, reuse and remanufacturing activities and how they may develop in the future. Against this background the guiding question is if the potential to create jobs in high unemployment regions, or in occupations that correspond with the skills of the unemployed? And, what contribution can a growing circular economy make to the phenomenon of declining mid-level occupations? To answer these questions, the study looked at British labour market trends and drivers and developed three distinct scenarios for the potential expansion of the circular economy to 2030.

The first scenario involves no new initiatives and a very limited increase in the ‘circularity’ of the economy. The second envisages a continuation on the current trajectory, with significant further increases in recycling and remanufacturing likely. The third scenario is really transformational, with substantial progress in recycling and remanufacturing, but also major development of the reuse, servitisation and biorefining sectors. To illustrate each scenario the authors undertook quantitative analysis that suggests that growth in the circular economy can be expected to have lasting beneficial effects on the labour market. This is because, whilst these activities tend to be efficient in their use of natural resources, they can be relatively intensive in their use of labour, compared with the activities they replace. They have the capacity to create dispersed employment that could potentially be undertaken by those currently unemployed, or those losing mid-level skilled positions due to industrial change. The calculations suggest that by 2030, on the basis of the current development path, the circular economy could create over 200,000 gross jobs and reduce unemployment by about 54,000. It could also have the potential to offset around seven per cent of the expected decline in skilled employment to the year 2022. More extensive expansion of circular economy activities could more than double these figures, creating around half a million jobs (gross), reducing unemployment by around 102,000, and potentially offsetting around 18 per cent of the expected loss in skilled employment over the next decade. Figure 12 illustrates the likely range of skills needed for open loop recycling, remanufacturing and biorefining.

Figure 12: Potential skill needs by circular economy activity

Activity	Low skilled	Skilled	Professional
Closed loop recycling	4 icons	4 icons	1 icon
Open loop recycling	4 icons	2 icons	1 icon
Servitisation	3 icons	3 icons	3 icons
Remanufacturing	2 icons	5 icons	2 icons
Reuse	4 icons	2 icons	1 icon
Biorefining	1 icon	4 icons	4 icons

Source: <https://wrap.org.uk/sites/default/files/2021-02/WRAP-Employment-and-the-circular-economy-summary.pdf>

Conclusions from the literature review

The overview on the state of the art with regard to research, analysis and implementation of tools and policies to identify necessary skill sets for a circular economy especially highlights the complexity of the topic. Circular economy can be seen as an overarching concept that includes very different strategies that in practice will have limited interlinkages especially with regard to necessary qualifications, e.g. when it comes to developing circular product designs and in the end collect discarded products – although both activities need to be much more closely connected in order to achieve circularity.

The three key take aways from the literature review can be summarized as follows:

- There is a high level of uncertainty with regard to specific jobs/ roles that support the transformation towards a circular economy
- At the moment there is a strong focus on university education, e.g. vocational training is often underrepresented in strategic discussion on circular skill sets
- A key challenge is the lacking differentiation of different R-strategies

Against this background an analytical framework is needed that covers these very different activities and structures them in a way that allows to specify necessary skills. For the purpose of the TICHE project, the DISRUPT framework has been used, see following Figure 13.



Figure 13: The DISRUPT framework for the circular economy

Source: https://assets.website-files.com/5d26d80e8836af2d12ed1269/5e6897dafa8092a5a678a16e_202003010%20-%20J%26S%20in%20the%20circular%20economy%20report%20-%20297x210.pdf

The DISRUPT framework is a comprehensive list of circular strategies. It includes 80 tangible strategies that provide guidance, focusing on economic actors that aim to develop circular products and services. These are wide-ranging: design guidance, decisions concerning inputs, use, and end-of-life, business

models and collaboration in the supply chain and in the use of digital technologies to support circularity¹¹.

The specific opportunity of the framework is that it allows to directly link different core strategies to concrete examples of roles or jobs in a circular environment¹².

1. **Design for the future**

Circular equipment engineers design products to enable parts and resource recovery after the product's use phase. They excel in complex problem solving on a technical level designs for the future.

2. **Incorporate digital technology**

Building information managers maintain data on construction components so as to keep track of these physical assets. They understand how to integrate and interpret virtual information management systems.

3. **Sustain and preserve what's already there**

Repair technicians repair appliances, machines or vehicles. They possess strong technical and manual skills which can be acquired through a formal and informal education and training.

4. **Rethink the business model**

Demand planners oversee supply and demand to make refurbishment a profitable business model. This role requires logical thinking and reasoning.

5. **Use waste as a resource**

Process operators sort waste for sellable products, for example to produce livestock feed made from waste flows. Although classed as practical-skill work, knowledge of the quality of incoming raw materials is crucial.

6. **Prioritise regenerative resources**

Agronomic advisors support healthy soil nourishment with organic fertiliser from composted manure and crop remnants. They combine strong interpersonal skills with ecological knowledge.

7. **Team up to create joint value**

¹¹ <https://www.circle-economy.com/resources/the-disrupt-framework>

¹² https://assets.website-files.com/5d26d80e8836af2d12ed1269/5e6897dafa8092a5a678a16e_202003010%20-%20J%26S%20in%20the%20circular%20economy%20report%20-%20297x210.pdf

8. Procurement professionals stimulate the demand for secondary materials and discern and connect new suppliers in order to do so. This profile points to the need for entrepreneurial, interpersonal skills.

Identification of concrete skills for the circular economy

The ESCO skill classification system

In order to identify concrete skills that would allow employees to work in the different areas of a circular economy as described above, the DISRUPT framework has been used as a filter methodology for skills listed in ESCO. ESCO is the multilingual classification of European Skills, Competences, Qualifications and Occupations¹³. The ESCO classification identifies and categorises skills, competences, qualifications and occupations relevant for the European labour market and education and training. To our knowledge it has until now not been used to derive concrete skill sets for a circular economy.

The Commission has developed ESCO to improve the communication between the education and training sector and the EU labour market by making data more transparent and easily available for use by various stakeholders, such as public employment services, statistical organisations and education organisations. The idea of ESCO is to support evidence-based policy making by enhancing the collection, comparison and dissemination of data in skills intelligence and statistical tools, and enabling better analysis of skills supply and demand in real-time based on big data. Against this background the identification of specific skills with relevance for specific circular activities would allow a direct interlinkage between an established skill categorization system and ongoing projects on skill development for CE.

ESCO is organised in three pillars: the occupations pillar; the knowledge, skills and competences pillar; the qualifications pillar.

These generic concepts are differentiated as follows¹⁴:

- Knowledge: The body of facts, principles, theories and practices that is related to a field of work or study. Knowledge is described as theoretical and/or factual, and is the outcome of the assimilation of information through learning.
- Skill: The ability to apply knowledge and use know-how to complete tasks and solve problems. Skills are described as cognitive (involving the use of logical, intuitive and creative thinking) or practical (involving manual dexterity and the use of methods, materials, tools and instruments).

¹³ <https://esco.ec.europa.eu/en/publication/esco-handbook>

¹⁴ European Skills, Competences, Qualifications and Occupations. ESCO handbook: PART I – WHAT IS ESCO?

- Competence: The proven ability to use knowledge, skills and personal, social and/or methodological abilities, in work or study situations, and in professional and personal development.

This three-layered structured approach allows ESCO to organise terminology for the European labour market and the education/training sector in a consistent, transparent and usable way. The



development was based on the analysis of a wide range of existing national and sectoral classifications, inter alia the European Dictionary of Skills and Competences (DISCO).

Figure 14: The ESCO ecosystem

Source: <https://esco.ec.europa.eu/en/about-esco/what-esco>

The following analysis in context of the TICHE project focused specifically on the “skills pillar”. That provides a comprehensive list of skills that are relevant for the European labour market. The current version of the ESCO database (Version 1) contains in total 13.485 specific skills.

The ESCO skills pillar does not contain a full, top-down hierarchical structure. Instead, the 13 485 elements of the pillar are structured in different complementary manners, e.g. through their relationship with occupations, by using occupational profiles as an entry point; or through relationships indicating how knowledge, skills and competences are relevant to other knowledge, skills and competences;

Content of the skills pillar

ESCO provides metadata for each concept in the skills pillar that inter alia include a short description that explains more in depth what the skill is about in line with the action verb and level of detail used in the title.

It also presents the relationship with the ESCO occupations database. This shows for which occupations the knowledge, skill or competence is typically relevant including those for which it is essential and those for which it is optional. In some cases, a relationship will show how the knowledge, skill or competence is relevant for other knowledge, skills and competences.

The ESCO follows an approach of “skill contextualization” that offers unique opportunities to identify necessary skills for a complex transformation approach like the circular economy. Skill contextualisation is a method to create knowledge or skill and competence concepts by analysing how transversal skills, competences or knowledge are applied in the specific context of a sector or an occupation. This allows transversal knowledge, skills and competences that are rather abstract to be brought to a more detailed level so that they can be directly used in occupational profiles. Through skill contextualisation, the skill



The screenshot shows the ESCO database entry for the occupation 'recycling specialist'. At the top, the title 'recycling specialist' is displayed in a blue header bar, with options for 'Discuss in the forum' and 'Download'. Below the header, a breadcrumb trail indicates the navigation path: 'Professionals > Science and engineering professionals > Engineering professionals (excluding electrotechnology) > Environmental engineers > environmental engineer > recycling specialist >'. The main content area is divided into sections: 'Description' (with a horizontal line below the title), 'Code' (displaying '2143.1.3'), and another 'Description' section (displaying the text: 'Recycling specialists research recycling policies and legislation, and supervise implementation in an organisation to ensure that waste management occurs according to regulations. They perform inspections, provide recycling equipment, and supervise recycling workers. They also advise organisations on ways they can improve their waste management procedures.').

can be made more specific. The following figure gives an example for a specific occupation that allows to put skills in a specific context.

Figure 15: Exemplary occupation description within the ESCO database

Source: https://esco.ec.europa.eu/en/classification/occupation_main

As an additional information, ESCO indicates a certain “reusability level” for each skill. This reusability level indicates how widely a knowledge, skill or competence concept can be applied. This is crucial for supporting occupational mobility. ESCO distinguishes four levels of skill reusability:

- Transversal knowledge, skills and competences are relevant to a broad range of occupations and sectors;
- Cross-sector knowledge, skills and competences are relevant to occupations across several economic sectors;
- Sector-specific knowledge, skills and competences are specific to one sector, but are relevant for more than one occupation within that sector;
- Occupation-specific knowledge, skills and competences are usually applied only within one occupation or specialism.

CE skills based on the ESCO database

The following lists relevant skills from the ESCO database for all seven subcategories of the DISRUPT framework of circularity introduced above.

For the identification of these specific skills the key terms from the category definitions have been used to conduct a database search from all 13.485 skills listed in the ESCO database.

Where possible also concrete occupations have been used to validate the search outcomes and to identify additional skills of relevance. The list does not aim to indicate every skill that might somehow be of relevance but has been limited to the 10-15 most important skills.

- Design for the future:

Skill	Description
analyse production processes for improvement	Analyse production processes leading toward improvement. Analyse in order to reduce production losses and overall manufacturing costs.
draft design specifications	List the design specifications such as materials and parts to be used and a cost estimate.
design component interfaces	Use methods and tools to design and program interfaces of software and system components.
develop design plans	Develop design plans by using computer-aided-design (CAD); work in accordance with budget estimates; organise and conduct meetings with clients.

draw design sketches	Create rough pictures to assist in creating and communicating design concepts.
design prototypes	Design prototypes of products or components of products by applying design and engineering principles.
create a product's virtual model	Create a mathematical or three-dimensional computer graphic model of the product by using a CAE system or a calculator.
calculate design costs	Calculate design costs to make sure the project is financially viable.
adapt existing designs to changed circumstances	Adapt an existing design to changed circumstances and ensure that the artistic quality of the original design is reflected in the final result.
build a product's physical model	Build a model of the product out of wood, clay or other materials by using hand or electrical tools.
use CAD software	Use computer-aided design (CAD) systems to assist in the creation, modification, analysis, or optimisation of a design.
perform physical stress tests on models	Perform tests on products' models to analyse the ability of products to endure temperature, loads, motion, vibration and other factors.
determine production feasibility	Determine if a product or its components can be produced by applying engineering principles.

- Incorporate digital technology

Skill	Description
use digital instruments	Use computers or synthesizers to compose and arrange music.

develop digital content	Create and edit digital content in different formats, express oneself through digital means.
handle warranty for digital equipment	Provide internal customers with warranty documentation used for digital equipment.
create digital files	Create digital files in the computer system after quality checking printing or scanned documents for malfunctions.
use digital illustration techniques	Create drawings using digital illustration programmes and techniques.
apply digital mapping	Make maps by formatting compiled data into a virtual image that gives a precise representation of a specific area.
lay out digital written content	Lay out pages by selecting sizes, styles and entering text and graphics into computer systems.
teach digital literacy	Instruct students in the theory and practice of (basic) digital and computer competency, such as typing efficiently, working with basic online technologies, and checking email. This also includes coaching students in the proper use of computer hardware equipment and software programmes.
copyright and licenses related to digital content	Understand how copyright and licences apply to data, information and digital content.
digital communication and collaboration	Communicate in digital environments, share resources through online tools, link with others and collaborate through digital tools, interact with and participate in communities and networks, cross-cultural awareness.
use online tools to collaborate	Use online resources such as online meeting tools, VoIP conference calling, concurrent file editing, to co-create, share content and collaborate from remote locations.
use ICT resources to	Choose and use ICT resources in order to solve related tasks.

solve work related tasks	
creatively use digital technologies	Use digital tools and technologies to create knowledge and to innovate processes and products. Engage individually and collectively in cognitive processing to understand and resolve conceptual problems and problem situations in digital environments.
work with virtual learning environments	Incorporate the use of online learning environments and platforms into the process of instruction.
integrate and re-elaborate digital content	Modify, refine, improve and integrate information and content into an existing body of knowledge to create new, original and relevant content and knowledge.
use computerised maintenance management systems	Use computerised maintenance management systems (CMMS) in order to facilitate effective follow up of the work undertaken in maintenance facilities.
problem-solving with digital tools	Identify digital needs and resources, make informed decisions on most appropriate digital tools according to the purpose or need, solve conceptual problems through digital means, creatively use technologies, solve technical problems, update own and other's competence.
utilise decision support system	Use the available ICT systems that can be used to support business or organisational decision making.
collaborate through digital technologies	Use digital tools and technologies for collaborative processes, and for co-construction and co-creation of resources and knowledge.

- Sustain and preserve what's already there

Skill	Description
maintain plant health	Manage and support overall plant health. Practice sustainable gardening techniques and integrated pest management in gardens both outdoor and indoor.

maintain parts inventory	Maintain stock levels in accordance with organisation procedures and policies; estimate upcoming supply needs.
maintain recycling records	Maintain records and process facts and figures about type and volume of different recycling operations.
ensure compliance with waste legislative regulations	Implement and monitor company procedures for the collection, transport and disposal of waste, in compliance with all regulations and legal requirements.
oversee quality control	Monitor and assure the quality of the provided goods or services by overseeing that all the factors of the production meet quality requirements. Supervise product inspection and testing.
ensure compliance with environmental legislation	Monitor activities and perform tasks ensuring compliance with standards involving environmental protection and sustainability, and amend activities in the case of changes in environmental legislation. Ensure that the processes are compliant with environment regulations and best practices.
analyse environmental data	Analyse data that interpret correlations between human activities and environmental effects.
advise on equipment maintenance	Advise customers on the appropriate products, methods and, if necessary, interventions to ensure proper maintenance and prevent premature damage of an object or an installation.
check for damaged items	Identify products that have been damaged and report the situation.
schedule regular machine maintenance	Schedule and perform regular maintenance, cleaning, and repairs of all equipment. Order necessary machine parts and upgrade equipment when necessary to ensure optimal performance.

manage maintenance operations	Oversee maintenance activities, making sure that staff is following procedures and ensuring routine and periodic refurbishment and maintenance activities.
ensure compliance with maintenance legislation	Guarantee compliance with building regulations, licensing, legal requirements, electrical installations and health and safety procedures.
use testing equipment	Use equipment to test performance and operation of machinery.
perform machine maintenance	Perform regular maintenance, possibly including corrections and alterations, on a machine or machine tool to ensure it remains in a proper productive state.
resolve equipment malfunctions	Identify, report and repair equipment damage and malfunctions. Communicate with field representatives and manufacturers to obtain repair and replacement components.
advise on efficiency improvements	Analyse information and details of processes and products in order to advise on possible efficiency improvements that could be implemented and would signify a better use of resources.
estimate restoration costs	Estimate the cost implications of restoring and replacing products or parts.
provide customer information related to repairs	Inform customers about necessary repairs or replacements, discuss products, services and costs, include accurate technical information.
perform risk analysis	Identify and assess factors that may jeopardise the success of a project or threaten the organisation's functioning. Implement procedures to avoid or minimise their impact.
use computerised maintenance	Use computerised maintenance management systems (CMMS) in order to facilitate effective follow up of the work undertaken in maintenance facilities.

management systems

- Rethink the business model

Skill	Description
collaborate in the development of marketing strategies	Work together with a group of professionals to develop marketing strategies performing market analysis and financial viability while staying aligned with the company's goals.
carry out sales analysis	Examine sales reports to see what goods and services have and have not sold well.
study sales levels of products	Collect and analyse sales levels of products and services in order to use this information for determining the quantities to be produced in the following batches, customer feedback, price trends, and the efficiency of sales methods.
identify new business opportunities	Pursue potential customers or products in order to generate additional sales and ensure growth.
analyse business plans	Analyse the formal statements from businesses which outline their business goals and the strategies they set in place to meet them, in order to assess the feasibility of the plan and verify the business' ability to meet external requirements such as the repayment of a loan or return of investments.
develop professional network	Reach out to and meet up with people in a professional context. Find common ground and use your contacts for mutual benefit. Keep track of the people in your personal professional network and stay up to date on their activities.
use analytics for commercial purposes	Understand, extract and make use of patterns found in data. Use analytics to describe consistent happenings in observed samples in order to apply them to commercial plans, strategies, and corporate quests.
conduct public presentations	Speak in public and interact with those present. Prepare notices, plans, charts, and other information to support the presentation.

assess environmental impact	Monitor environmental impacts and carry out assessments in order to identify and to reduce the organisation's environmental risks while taking costs into account.
manage financial risk	Predict and manage financial risks, and identify procedures to avoid or minimise their impact.
perform business analysis	Evaluate the condition of a business on its own and in relation to the competitive business domain, performing research, placing data in context of the business' needs and determining areas of opportunity.
conclude business agreements	Negotiate, revise, and sign mercantile and business documents such as contracts, business agreements, deeds, purchases and wills, and bills of exchange.
develop business plans	Plan, write and collaborate in the implement business plans. Include and foresee in the business plan the market strategy, the competitive analysis of the company, the design and the development of the plan, the operations and the management aspects and the financial forecast of the business plan.
identify customer's needs	Use appropriate questions and active listening in order to identify customer expectations, desires and requirements according to product and services.
handle lease agreement administration	Draw up and handle the contract between a lessor and lessee that allows the lessee rights to the use of a property owned or managed by the lessor for a period of time.
achieve sales targets	Reach set sales goals, measured in revenue or sold units. Reach the target within a specific timeframe, prioritise sold products and services accordingly and plan in advance.

- Prioritise regenerative resources

Skill	Description
develop advanced materials	Select materials for further exploration and conduct material synthesis experiments to support the development of advanced materials.
test materials	Test the composition, characteristics, and use of materials in order to create new products and applications. Test them under normal and extraordinary conditions.

assess environmental impact	Monitor environmental impacts and carry out assessments in order to identify and to reduce the organisation's environmental risks while taking costs into account.
forecast organisational risks	Analyse the operations and actions of a company in order to assess their repercussions, possible risks for the company, and to develop suitable strategies to address these.
develop material testing procedures	Develop testing protocols in collaboration with engineers and scientists to enable a variety of analyses such as environmental, chemical, physical, thermal, structural, resistance or surface analyses on a wide range of materials such as metals, ceramics or plastics.
analyse production processes for improvement	Analyse production processes leading toward improvement. Analyse in order to reduce production losses and overall manufacturing costs.
adjust engineering designs	Adjust designs of products or parts of products so that they meet requirements.
integrate new products in manufacturing	Assist with the integration of new systems, products, methods, and components in the production line. Ensure that production workers are properly trained and follow the new requirements.
advise on waste management procedures	Advise organisations on the implementation of waste regulations and on improvement strategies for waste management and waste minimisation, to increase environmentally sustainable practices and environmental awareness.
assess the feasibility of implementing developments	Study developments and innovation proposals in order to determine their applicability in the business and their feasibility of implementation from various fronts such as economic impact, business image, and consumer response.
design prototypes	Design prototypes of products or components of products by applying design and engineering principles.
advise on pollution prevention	Advise individuals and organisations on the development and implementation of actions which aid in the prevention of pollution and its related risks.

define quality standards	Define, in collaboration with managers and quality experts, a set of quality standards to ensure compliance with regulations and help achieve customers' requirements.
promote sustainable interior design	Develop an environmental friendly interior design and promote the use of cost-effective and renewable materials.
promote sustainable packaging	Apply safe and healthy packaging policies; maximise the use of recycled or renewable source materials; implement clean production technologies.
use sustainable materials and components	Identify, select environmentally friendly materials and components. Decide on the substitution of certain materials by the one that are environmentally friendly, maintaining the same level of functionality and other characteristics of the product.
advise customers on building materials	Provide customers with detailed advice on various building materials; recommend sustainable development and promote the use of green materials such as wood, straw and bamboo; promote recycling and the use of renewable or non-toxic materials.
advise on sustainable management policies	Contribute to planning and policy development for sustainable management, including input in environmental impact assessments.
advise on sustainability solutions	Advise companies on solutions to develop sustainable production processes, improve material efficiency and reuse and reduce carbon footprint.
select sustainable technologies in design	Produce a holistic design, which includes passive measures that are complemented by active technologies in a sensible way.
coordinate shipments of recycling materials	Coordinate and oversee shipments of recycling materials. Communicate with processing companies and shipping brokers.

promote responsible consumer behaviour	Promote policies, actions and education programmes that encourage healthy lifestyles and proactive participation in sustainable consumption, and that lead to changes in consumers' attitudes, shopping habits and expectations.
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- Team up to create joint value

Skill	Description
create social alliances	Build cross-sector long-term relationships with stakeholders (from public, private or non-profit sector) to achieve common goals and address common societal challenges through their joint capabilities.
maintain relationship with suppliers	Build a lasting and meaningful relationship with suppliers and service providers in order to establish a positive, profitable and enduring collaboration, co-operation and contract negotiation.
establish collaborative relations	Establish a connection between organisations or individuals which may benefit from communicating with one another in order to facilitate an enduring positive collaborative relationship between both parties.
maintain the trust of service users	Establish and maintain the trust and confidence of the client, communicating in an appropriate, open, accurate and straightforward way and being honest and reliable.
develop professional network with researchers and scientists	Develop alliances, contacts or partnerships, and exchange information with others. Foster integrated and open collaborations where different stakeholders co-create shared value research and innovations. Develop your personal profile or brand and make yourself visible and available in face-to-face and online networking environments.
improve customer interaction	Permanently refine and improve the quality of customer interaction and customer satisfaction; make continuous efforts to improve business standards.
stimulate creativity in the team	Use techniques like brainstorming to stimulate creativity in the team.
seek innovation in	Search for improvements and present innovative solutions, creativity and alternative thinking to develop new technologies, methods or ideas for and answers to work-related problems.

current practices	
identify innovative concepts in packaging	Search for improvements and present innovative solutions, creativity and alternative thinking to develop new technologies, methods or ideas for and answers to work-related problems.
stimulate creative processes	Encourage and foster creative processes from setting up brainstorming sessions, incubating ideas, up to contrasting them with other ideas and undergoing feasibility tests of the prospects.
develop creative ideas	Developing new artistic concepts and creative ideas.
develop design ideas cooperatively	Share and develop design ideas with the artistic team. Conceptualise new ideas independently and with others. Present your idea, gain feedback and take it into account. Make sure the design fits with the work of other designers.
cooperate to resolve information issues	Meet up and communicate with managers, salesmen, and others to facilitate cooperation and resolve problems.
encourage teambuilding	Stimulate teambuilding activities. Coach employees in order to help them reach their goals.
stimulate creativity in the team	Use techniques like brainstorming to stimulate creativity in the team.
stimulate creative processes	Encourage and foster creative processes from setting up brainstorming sessions, incubating ideas, up to contrasting them with other ideas and undergoing feasibility tests of the prospects.
shape organisational teams based on competencies	Study the profiles of collaborators and decide the best place for directors and collaborators following an strategic mindset and serving to the goals of the company.
encourage teams for	Empower teams to identify opportunities for continuous improvement and then drive the process to improve the results.

continuous improvement

- Use waste as a resource

Skill	Description
identify new recycling opportunities	Investigate ideas and spot opportunities to improve the collection, process and recycling of waste materials.
develop recycling programs	Develop and coordinate recycling programs; collect and process recyclable materials in order to reduce waste.
operate recycling processing equipment	Operate recycling processing equipment such as granulators, crushers and balers; process and sort materials to be recycled.
collect broken appliances	Collect or receive products which are no longer functional and cannot be repaired from households, organisations or collection facilities so that they can be sorted for disposal or recycling.
dismantle broken appliances	Dismantle equipment and appliances which are broken and ineligible for repair so that their separate components can be sorted, recycled, and disposed of in a manner which is compliant with waste and recycling legislation.
maintain recycling records	Maintain records and process facts and figures about type and volume of different recycling operations.
operate waste incinerator	Operate a type of furnace which is used for the burning of waste, and which may facilitate energy recovery, compliant with regulations.
monitor incineration process	Monitor the procedures involved in the incineration of waste and potential energy recovery from the process, to ensure that it is compliant with health, safety and environmental regulations as well as to ensure efficiency and proper functioning of the incineration equipment.
dispose waste	Dispose waste in accordance with legislation, thereby respecting environmental and company responsibilities.

inspect waste disposal facilities Inspect industrial and commercial waste disposal facilities in order to examine their waste permits and if their equipment is in conformity with regulations.

Conclusion

The analysis of the seven circular strategies and related necessary skills highlights the broad range of competences that will be necessary to transform our patterns of production and consumption in the necessary time. “Circular skills” can mean a lot, very much depending on the specific context.

Looking at the classification of knowledge within the ESCO database, many of the necessary skills are linked to so-called “transversal knowledge, skills and competences”. They are often referred to as core or soft skills and are considered the cornerstone for the personal development of a person. Within the skills pillar, transversal skills and competences are characterized with the following five headings: thinking, language, application of knowledge, social interaction as well as attitudes and values.

As mentioned above, transversal knowledge, skills and competences are relevant to a broad range of occupations and economic sectors. It is also challenging to acquire in formalized educational settings and often requires years of experience and on-the-job training. Another differentiation of circular skills refers to economic sectors and types of services that contribute in very different ways to increased circularity. The skills listed above can be linked to three different types of circular jobs¹⁵:

- **Core circular jobs:** ensuring closed raw material cycles, e.g. jobs in renewable energy, repair and waste and resource management sectors
- **Enabling circular jobs:** enabling the acceleration and upscaling of core circular activities
- **Indirect circular jobs:** providing services to the primary circular activities

Based on these three dimensions – types of circular jobs, circular strategies and concrete skills, a possible way to allow an interactive visualization could be a tool similar to the ESCO Covid 19 Skills Watcher, see Figure XY.

¹⁵ https://assets.website-files.com/5d26d80e8836af2d12ed1269/5e6897dafa8092a5a678a16e_202003010%20-%20J%26S%20in%20the%20circular%20economy%20report%20-%20297x210.pdf

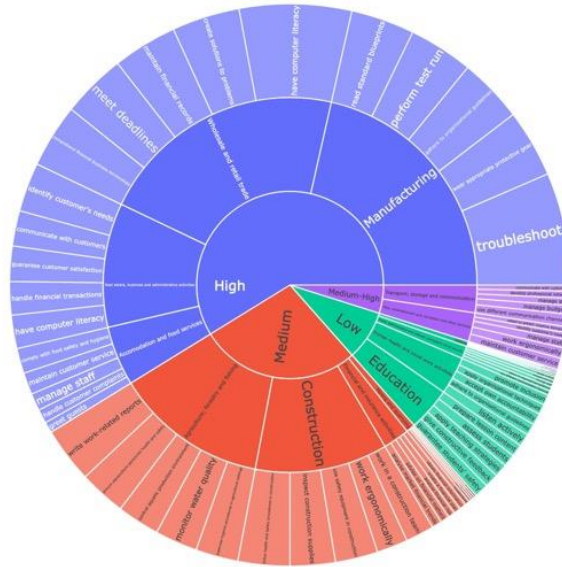


Figure 16: The COVID-19 Skills Watcher and its three dimensions of skills

Source: <https://esco.ec.europa.eu/en/about-esco/data-science-and-esco/covid-19-skills-watcher>

The COVID-19 Skills watcher consists of an interactive 3-levels pie chart that could be used as a template also for circular skills:

- The first level of the COVID-19 Skills watcher describes 4 different degrees of impact of the Coronavirus crisis in the output of global economic sectors. This could be translated to the seven different circular strategies as described in Chapter 3.
- The second level lists 14 economic sectors, each of them included in one of the four impact levels. The size of the sector within the chart reflects the share of global employment of that sector, based on ILO data. With regard to circular skills, this could be differentiation of circular jobs into core, enabling and indirect circular jobs in the different clusters of the DISRUPT framework.
- The third and last level lists 70 skills, which represent the 5 skills defined as essential for the higher number of occupations within every sector. This relates to the identified ESCO skills as described in Chapter 5.

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R2 CIRCULAR SKILLS CATCHER