

Article

Barriers to Efficient Knowledge Transfer for a Holistic Circular Economy: Insights towards Green Job Developments and Training for Young Professionals

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Abstract: There is a growing interest in adopting a holistic circular economy (CE) to reach a sustainable and economically viable future, thus there is an increasing need for professionals in the field to do so efficiently. In this regard, good education and knowledge sharing are crucial. This knowledge sharing is bi-directional across generations, with everyone gaining equally from the various viewpoints and experiences. CE strategy research and education are beneficial for the implementation of sustainable development that considers economic, social, and environmental spheres. Additionally, attention is being paid to the younger generation, which is now focused on addressing climate change, as evidenced by the growth of the post-Greta Thunberg phenomena. As a result, this paper proposes a set of recommendations to improve measures for circular economy education (ECE) in order to train future CE experts who can contribute to achieving successful sustainable development. This research proposes, through a literature review and case studies analyses, that enhancing ECE can cultivate future CE specialists who can contribute to the successful pursuit of sustainable development as the demand for green jobs grows. According to our preliminary understanding, widespread ECE can be a critical tool for bringing together experienced circular professionals, students, and younger generations, in meeting their needs and advancing circular development through various forms, including specific training and reskilling of professionals required. However, we discovered a lack of consensus across the case studies on the ideal CE expert or educational modality, which is mirrored in the literature, indicating the need for greater collaboration among different disciplines and stakeholders. There also appears to be a general lack of awareness about the benefits of the CE, necessitating the collaboration between the private and public sectors in providing educational opportunities, accessible study materials, and research funding to accelerate innovation and competitiveness. Thus, institutions and businesses could play a role in standardising basic circular principles and competencies in CE as a means of providing basic guidelines that could be supplemented with specialised courses and diverse content ranging from public knowledge to more specialised professionals or students aiding the implementation of CE strategies, which reduce local disparities increasing green jobs accessibility for youth. Conclusively, this paper looks to provide recommendations for improvements in this field.

Keywords: circular economy; youth; green jobs; education; knowledge; jobs; environmental sustainability; education for circular economy



Citation: Guerreschi, A.; Piras, L.; Heck, F. Barriers to Efficient Knowledge Transfer for a Holistic Circular Economy: Insights towards Green Job Developments and Training for Young Professionals. *Youth* **2023**, *3*, 553–578. <https://doi.org/10.3390/youth3020038>

Academic Editors: Diego Gomez-Baya and Todd Michael Franke

Received: 4 January 2023

Revised: 24 March 2023

Accepted: 17 April 2023

Published: 19 April 2023



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1. Introduction

Governments, academia, and businesses are gaining interest in circular economy (CE) for its anticipated financial, social, and environmental benefits [1,2], especially small-medium enterprises (SMIs) [3]. Additionally, larger firms are experiencing a trend toward environmental sustainability leading to a shortage of workers with the relevant skills

needed for the green transition [4]. Moreover, CE is now widely recognized as a technique for achieving environmental sustainability [5]. Both the European Union (EU) and China have been at the forefront of this effort [1,6], with China leading the way in 2015 [7] drafting and creating policies to implement CE strategies. As a result of the Green New Deal, the EU drafted the Circular Economy Action Plan (CEAP), identifying key actions that should accelerate the implementation of CE strategies.

When focusing on textiles, the EU Strategy for Sustainable and Circular Textiles' subpoint 3.5 focuses on "Developing the skills needed for the green and digital transitions" [8]. It underlines that hiring adequately trained employees is not always possible. The subpoint's primary objective is not only to implement strategies that support creating local partnerships between industry, public authorities, and educational providers in this field, yet support educational processes, insertion of more women in higher management positions—or in specific green jobs (GJs) where women are generally underrepresented [9]—diversifying the skills provided within the same company, and reskilling already present employees. It also underlines the need to create educational processes and tools for CE application accelerated by the implementation of greener forms of innovation that require trained expertise [10]. Education, as in higher education institutions (HEI), is already noted as extremely relevant in this imminent and ongoing transition to environmental sustainability [11,12].

The economic crisis led by COVID-19 has prompted a review of employment levels, particularly for youth, and the educational level was observed an important variable to consider for sustaining human development and for reducing imbalances generated by the economic crisis [13]. Increased interest in CE has led to a growth of GJs, however, research identifies "... a lack of uniform methods for measuring and forecasting the effects of GJs creation and indicates future research directions" [14]. The role that youth plays in this transition via "green jobs" can support companies to achieve reduced reliance on finite resources, generate economic growth that is decoupled from resource consumption, and effectively create a sustainable CE. Moreover, GJs require higher levels of education, work experience, and job training, as well as higher levels of cognitive and interpersonal skills [15]. Hence, we must acknowledge that there are several relevant factors in play for younger professionals in this field.

CE strongly impacts numerous stakeholders, although due to a lack of attention, the social impact has currently been deemed little in this context. In this regard, employee relationships have been identified as a highly relevant social circularity indicator (SCI) [16]. Hence, the role of education of employees in this transition is not only crucial for the implementation of CE, but also to enhance the relationship between employees and firm decision-makers in achieving social sustainability. CE's positive impact on socioeconomic factors has also been previously identified and confirmed [5]. Therefore, in view of the following considerations, we pose the following questions:

Q1: How can CE be effectively implemented to positively impact stakeholder relationships and the social economy by identifying the requisite skills and specialists needed?

Q2: What role does education play in supporting the implementation of CE strategies, particularly in facilitating young people's acquisition of the necessary knowledge and skills through educational channels to effectively perform "green jobs" in the present and future?

While the CE key strategies are shared and acknowledged [17], we want to highlight the current literature in the academic field focusing on education for the CE (ECE) [18] and GJs developed in Section 2, and recommendations are provided in Section 5.

The acquisition of data is divided into two sections. In Section 4, we explain and present the results using Google Search on ECE available in different European countries with a Virtual Private Network (VPN) aimed at investigating course accessibility. In Section 4.2, we present the results from a questionnaire completed by three different stakeholders, used as descriptive case studies, who have implemented ECE. To conclude, Sections 5 and 6 list suggested recommendations in this field and provide limitations and conclusions.

The aim of this paper is to put forward a preliminary analysis on how ECE can be improved and implemented with the acknowledgement of the disagreements that might occur between various stakeholders, which, if tackled, can provide a collaborative solution towards an efficient circular system. This is carried out by highlighting the indirect positive outcomes that successful implementation of CE strategies has not only on the environment but on society, and in particular on youth as potential professionals in this field looking to be hired in GJs, requiring an adjustment to the mismatch between youths' requirements to be trained, firms' skills needed to implement efficient CE practices, and the ECE available.

2. Conceptual Framework

2.1. Literature Review (Phase 1)

Using the Scopus database, we chose the keywords "CIRCULAR ECONOMY" AND "EDUCATION" OR "TRAINING", yielding 127 results. These results were provided following a similar search for keywords "CIRCULAR ECONOMY" and "GREEN JOB*", yielding only 20 results. The singularity of each title was reviewed to identify those inherent to the topic discussed in this research, reducing the results to 39 papers (Appendix A). A bibliometric approach, understood as a set of quantitative methods used for analysing academic literature [19], was considered to review the current state of the art in reference to this paper's topic. However, in view of the few results provided, only an analysis of the discovered literature was deemed necessary for this paper's aims to provide a conceptual framework. It should be noted that most of the papers resulting from this search were published within the last five years, rendering the topic recent and potentially highlighting the need for this topic to further investigated.

2.2. Overview of the Topic

The United Nations Educational, Scientific and Cultural Organization (UNESCO)'s International Commission on the Futures of Education stressed that a new social contract is required to repair injustices while transforming the future to make a profound change in an ever-evolving world [20]. It is agreed that CE practices can reduce the injustice caused by the unsustainable use of resources causing injustice [4,20]. Furthermore, education is seen as a means of cultivating understanding and building knowledge for a socially just and environmentally sustainable future that can generate opportunities for collective advancement [20] (p. 10). The same report identifies that the definition of education must be reinvented to provide knowledge and innovation to establish new ways of thinking against past oppressions [20]. The link is underlined between accessibility, educational opportunities to fight inequalities, and the importance of increasing knowledge to bring about innovative thinking. As we observe a growing trend towards a greener labour market, there is a pressing need to address the scarcity of skilled workers, regional data on specific employment needs, and the widening digital infrastructure gap. Therefore, efforts are being made to minimize the potential mismatch between job requirements and available skills in the workforce [4].

There is no defined consensus on CE's definition [21] nor of green jobs (GJ) [4] and remains intertwined with different subfields and disciplines [22]. Kirchherr et al., (2017) [23], describe CE as "an economic system that replaces the 'end-of-life' concept with reducing, alternatively reusing, recycling, and recovering materials in production/distribution and consumption processes". It has been described as deriving from the principles of eco-efficiency and cradle-to-cradle aiming to reduce the negative consequences of production and consumption [24]. It is therefore known that the application of these aforementioned CE practices can lead to the reduction of poverty; however, the same must be implemented properly [25], requiring experts and valuable knowledge transfer.

ECE requirements and professional competence to successfully implement CE are recognized as necessary for the transition [22,26]. The same authors reflect on the necessity for vocational training and higher education to collaborate with businesses in order not

only to retrain professionals but form new professionals in ECE. Hence, we reviewed the previously discovered results in ECE, connecting them to the topic of GJ and CE.

Initially, it is interesting to note that several of these titles insert “CIRCULAR ECONOMY” (Appendix A) in the paper’s keywords; however, in the title and abstract, the focus lies specifically on sustainable development or environmental sustainability. This can be explained by the only paper, among our results, published back in 2006 [27], which highlights that considering CE’s complexity, and vicinity to achieve environmental sustainability, proper knowledge should be transferred via educational opportunities [11,26] otherwise distinction between the various fields is unclear. Additionally, when observing the impact of ECE on local experts, it was identified that collaboration among stakeholders is key to successfully implement CE, even more when these same have completed ECE [11].

While specific GJs, created from an increased application of CE strategies [13,28], appear to be necessary mostly within SMIs [29]—since bigger companies are already prone to action—it has been identified that ECE is relevant and necessary for many stakeholders, beyond firm size and affecting various stakeholders’ behaviour. This is also demonstrated by Moreno-Mondéjar et al., (2021) [30] who stated, contrary to Bassi and Guidolin (2021) [29], that larger firms are more inclined to provide GJs that could be reasonable if we consider firms’ profit availability to provide higher stipends for more technical employment, technological openness, and knowledge of green products.

Other analyses [18,31] were carried out by testing various ECE formats to render it not only adequate for students, but in such a way that it would not focus on one single CE phase [32,33]. CE workshops were deemed efficient in knowledge transfer for firms [34]. Furthermore, firms’ knowledge transfer opportunities are meant to tackle those miss outs of a State’s educational system, such as those observed in Thailand by upskilling and reskilling employees simultaneously reinforced greener awareness within the company [35], aiding the firm focus on social values and not only profit [36].

Kirchherr and Piscicelli (2019) [18] also recommended a new branch of research focusing on ECE. It could provide a stronger understanding of the various ECE forms existing that approaches different educational levels, formats, and addresses to members from different societal levels. The latter leads to spin-offs of potentially clean companies applying CE strategies and adapting regularly for social and local conditions [29] and providing value tangible outputs for all stakeholders [37]. Similar results were reached by Türkeli and Schophuizen (2019) [38] suggesting that learning, also in the field of CE, should be providing an economic, as well as an eco-sociological value in ways that could be translated as customizable forms of learning.

In the case of the implementation of CE strategies to save energy and to reduce greenhouse gases, [39] it was observed that the number of students in Europe studying in these fields did not significantly change. However, they recorded a movement of the same students traveling abroad to other Member States, particularly in Western Europe. While they could not verify the hypothesis, the authors theorized that it could be influenced by national policies towards energy saving and job requests. Increased mobility among youth between Member States could enhance the responsiveness of education and training to labour market needs, especially when stakeholders collaborate effectively across borders [29].

Williams et al., (2018) [40] identified, through an experiment, that collaboration between universities and other external private entities would provide the opportunity to train students in ECE more efficiently not only as a vehicle for learning, but also towards professional development.

Business management has been considered as having a critical role to translate CE in practice tackling the lack of a holistic view [17]. Transversal competencies are also required; therefore, it is not a straightforward process that focuses only on a single or a few fields of studies [41,42], instead encompassing and requiring training on several skills [22,37]. Since firms need to insert dynamic capabilities to stay on track with the policy requirements, and the changes, to achieve efficiency within the various sustainability spheres [36,43],

it is expected from new professionals, such as young professionals, to be well-trained and prepared for these GJs. In particular, the acquisition of these same skills can increase the employability potential for both young professionals and students [40], especially in rural areas or developing countries [25] where more GJs can be created thanks to CE and increased attention to green economy [44]. Thus, the creation of GJs can provide for youth in social terms.

In Italy, Giannoccaro et al., (2021) [12] identified that the most conventional “CE jobs” were related to waste management or product recovery and/or recycling. However, they also noted the emergence of a new professional figure of the “CE manager”. This role expects a person with a background in industrial engineering, for example, yet requires competences in economics, business leadership, and firm transformation. In the case of employment in waste management [45], it was identified that multiple roles within a firm are necessary, requiring the Involvement of the company as a whole and especially the public to do their part.

Education for sustainable development (ESD) shares the similar transversality, and the barriers as seen in ECE, where the educational path is fragmented by different approaches and lacking a comprehensive body of knowledge [46]. As explained, some focus only on the social dimension, others on the economic or entirely environmental.

In the academic sphere, Kirchherr and Piscicelli (2019) [18] acknowledged the potential of ECE, while recognizing the necessary role of the private sector, especially in CE increasing GJs [47]. The former identified ECE’s limitations, such as the need to insert it not just in the realm of sustainable development, but to also express the limitations of its transition openly in specific courses, such as greenwashing in CE [48,49]. Furthermore, it is crucial not only to include firms, thus the private sector, to increase the understanding of CE application—via ECE—but to provide an understanding of the relationship between private and public sectors, and why and how such partnerships are necessary for the application of CE strategies, aiming to protect social capital [50].

Considering the novelty of ECE, a limitation mentioned is the time that ECE course lecturers must prepare on new topics, as well as the time that it takes for institutions to prepare ECE courses [51] in absence of key performance indicators [31]. Structured unemployment is reduced, and more open positions are filled whenever the supply and demand of labour for particular competencies are better matched [22]. Therefore, not only young students, but also professionals, require (re)training, to properly apply CE so that it is not just a “buzzword”, but rather a systemic method [52].

Conclusively, it is noted that general “green” education, as with ECE, can be beneficial for young consumers [53]. Therefore, it could be linked to youth not only as professionals, but also as consumers, where education triggers behavioural changes [54,55]. University education can provide such change and similarly such tasks should be carried out also directly by firms.

Summarizing, ECE:

- Requires more attention in academia;
- Should be transversal;
- Should provide interaction with external bodies, such as firms;
- Should provide a hands-on approach;
- Should be frequently updated and adapted to the job market and eco-social needs and requirements;
- Should also be carried out by and within firms;
- Should also include courses that relate to economics and/or business and therefore be interdisciplinary;
- Should take into consideration the novelty of the topic and hence the difficulties that come with its preparation, differing potential audience/students/communities, and execution.

Specifically, it is understood that:

- Education fosters knowledge transfer;

- Adequate skill building provides youth with tools to enter the increasing work field of CE;
- Consensus is required to define educational processes, tools, and requirements to strongly implement efficient training opportunities also to non-degree holders or holders of different educational certifications.

According to this initial analysis, it appears that the description of the “CE manager” identified by Giannoccaro et al., (2021) [12] is the type of professional that we should expect is and will become necessary in a CE transition. However, what appears to be lacking from this review is potential research identifying barriers not only for young professionals facing access to ECE, but an efficient creation of an ECE curriculum and structure. Thus, this leads to further questions, such as who bears the responsibility to create these ECE, where funding can be accessed by the various stakeholders, and who then decides which ECE format or type is meant to be the more efficient and reliable.

It is important not only in view of the young professionals’ preparation to labour demands in a CE-oriented field, yet making sure that barriers, such as expensive courses, do not become a factor in reducing accessibility and hence putting more burden on social equality or at increasing current youth unemployment, reducing potentials leading to a “lost generation” [56].

The aim of this paper is to provide recommendations to strengthen educational practices in the field of CE acknowledging the increase of skills required in this field through a conceptual framework, and the accessibility of ECE courses that are currently present in multiple European capitals. Lastly, looking to gain an insight to ECE, and CE professionals, by presenting the results to a questionnaire answered by three respondents used as preliminary case studies.

3. Methodology

3.1. Detailed Methodology

The methodology (Table 1) used for this paper consists of four different phases: (Figure 1): (Phase 1) the state of the art about ECE, GJ, and CE; (Phase 2) availability of ECE training for future CE experts; (Phase 3) CE training and future CE specialization preparation requirements from on-the-job experience by CE experts; (Phase 4) final comparison and evaluation of results.

Table 1. Methodology phases and deliverables.

Phase	Deliverable
Phase 1: Scopus literature review on “circular economy” AND “education” OR “training” AND “green job*”.	Understanding the state-of-the-art of CE education, its needs, results, and challenges; Understanding the connection between CE and GJ.
Phase 2: Online ECE availability and accessibility using VPN connection in multiple European countries.	Availability for training evaluation looking at factors such as costs, execution mode, and accessibility.
Phase 3: Preliminary questionnaire design for interview with two CE experts and one ECE provider.	Perception of CE training and future CE experts’ preparation requirements from the on-the-job professionals’ experience.
Phase 4: Comparison of data, discussion, and conclusion providing a set of recommendations.	Understanding limits, requirements, and opportunities to implement a circular socio-economy through education and its impact on the creation and required skills for young professionals accessing GJs.

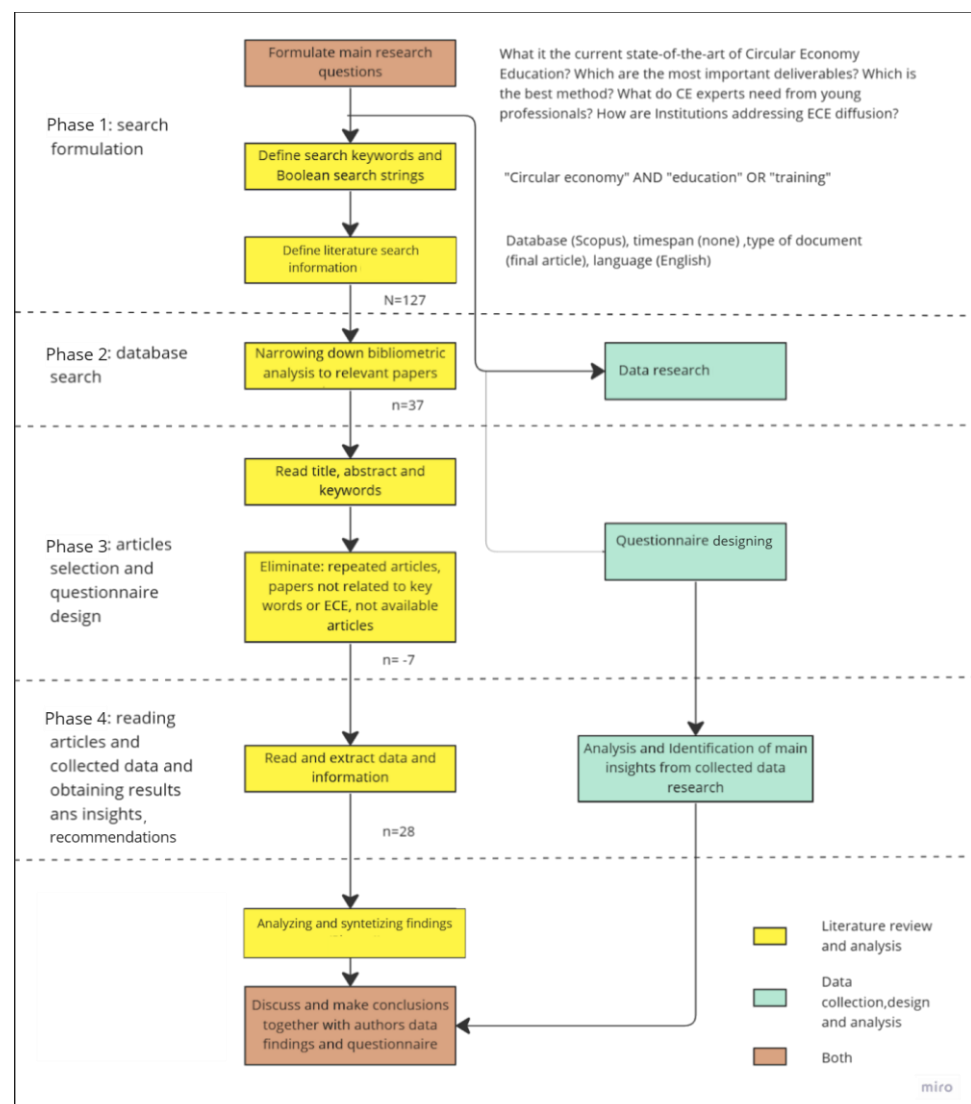


Figure 1. Methodology chart (own production on MIRO Software (Miro (2022). *Miro online white-board* (no version provided). RealTimeBoard, Inc. www.miro.com (accessed on 20 November 2022))).

3.1.1. Internet Search Assessment Using VPN (Phase 2)

Students who need to choose their future educational and training courses use the internet to select their preference [57]. Considering the importance of training future generations in crucial fields, such as sustainability and CE, it is essential to find out the solutions and results discovered online. We acknowledge that this is operation that can represent a challenge due to the numerous options and little clarity on the most reliable one.

For this paper, we assessed the availability and quantity of ECE among 10 different European countries, using a Google search engine and a VPN connection to ensure tailored local results and anonymity among all considered countries.

The chosen VPN is Surfshark, which is an accredited tool that provides all main features to provide safe and anonymous research (Appendix B).

We took as a representative example a total of 9 European countries chosen by geographical area, all part of the EU except for Norway. This parameter was chosen by picking a few countries for each European area (i.e., South, North, Central, and East Europe). This consideration was made to give, as much as possible, an overall perspective on ECE availability and to assess potential discrepancies among the different regions.

The selection of the countries was partially random yet identified by looking initially at the European Commission's results from monitoring CE implementation among Member States, potentially avoiding selecting countries either all part of the EU or that were all performing well in this field [58].

Among Southern European countries, Spain, Greece, and Italy were selected. France and Germany are representatives for Central Europe. Northern State Members considered were Finland, Norway, and Denmark, while Hungary represents Eastern Europe. The keywords used in the internet search were "Circular Economy course" translated into the national language for each country aiming to ensure locally focused results.

We collected all the respective top research results and ignored those shown in the results of paid advertisement. The top results from the Google search were deemed representative based on the parameters that are meant to guarantee content congruences, secure and reliable websites [59]. Therefore, these parameters take into consideration content that should be created to outreach to potential students. The considered variables are VPN location, total web results, course type, course target, modality, price, and course status (Appendix B).

3.1.2. Questionnaire Structure, Reasoning, and Deliverables (Phase 3)

The questionnaire is divided into five sections referring to: (1) background information of the respondent, (2) respondent perception of the ideal CE professional, (3) respondent perception on accessibility of knowledge transfer solutions, (4) respondent perception on forms of knowledge transfer, and (5) respondent perception on current limitations or standards. The intent is to identify the professional background (who), followed by its needs for the best CE expert preparation (what) and the best methodology (how and where) to organically train CE future experts, by considering the current limitations for ECE execution.

The (1) background information is used to understand the respondents' field of work and thus its needs, providing a baseline used to analyse and compare different perspectives on ECE. Since CE is an interdisciplinary and dynamic field, we wished to understand the most (2) valuable requirements in a young CE expert and the (3) best way to provide them with specific training, whether with traditional knowledge transfer, online tools, or innovative and practical forms of training. The final part investigates current limitations regarding expanding circular knowledge transfer, opportunities creation in ECE and the potential need for a central outline for ECE provided by institutions. The results of the questionnaire to the specific questions are (4) analysed in the following paragraph.

4. Results and Discussion

4.1. VPN Results

The preliminary analysis carried out with a VPN observed the results potentially discovered by a younger person browsing online about ECE or similar opportunities. We observed not only which results are available (Appendix B), but the accessibility in terms of costs and other options. We acknowledge that digital accessibility is important and therefore that information on ECE should also be provided on other platforms. Moreover, for the paper's purposes, and the known use of the digital tools by younger generations for online search as preferred media for information activities [60,61], this was deemed enough.

The first evident result could be described as expected. Higher results were noted, especially in those countries deemed at the forefront in implementing CE strategies, such as Italy, Germany, and France Figure 2 [55]. An assumption could be made that a government's actions—potentially setting the example—provides pressure for accelerated know-how at all levels (regional and local) to train future professionals. In fact, the relationship between regional green development and benefit acquisition from the green transition does depend on the local labour market, thus demonstrating that greening the policies in the

training and educational fields can provide the employment force necessary for greening the industries [4].

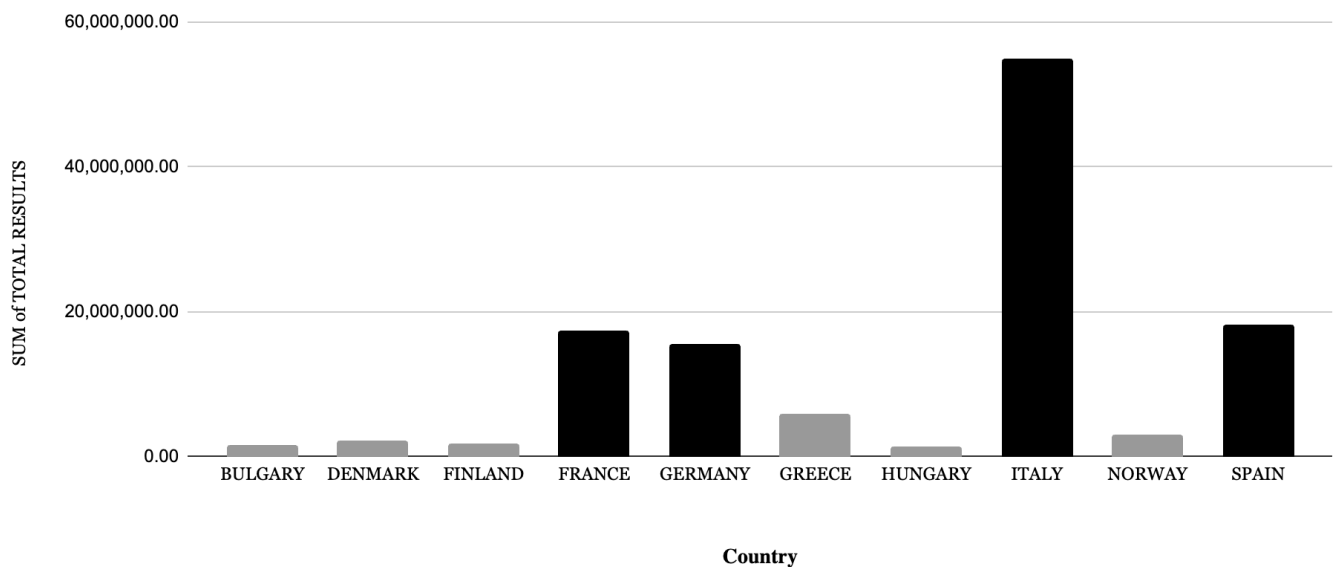


Figure 2. Sum of results from the Google search on ECE courses by EU countries using VPN connection.

As the results (Appendix B) show, the descriptions provided of specific ECE's webpage are not always clear. This is less observed for ECE offered by universities, which generally have a more standardized approach. Differing results are also observed for cost, accessibility, ECE type, and certification or final title provided.

A relevant detail observed, also specified in the conceptual framework, is that ECE mostly focuses on specific fields and/or a specific industry, as identified under "relevant studies access" (Table 2) that was the highest observed criteria for ECE.

Table 2. Results are grouped according to ECE operativity (closed or open), modality (on campus, blended, or online) and accessibility (understood as previous educational requirements necessary to access ECE).

Category	Category Description	Count
ECE Operativity/Status		
closed	This course is not operating anymore.	5
open	This course is still operating.	14
Modality		
on campus	This course is accessible in person.	9
blended	This course is accessible in person and online.	9
online	This course is only available online.	3
Accessibility/Course Target		
relevant studies access	The target category is open to people with relevant studies background/credits.	9
diploma	The target category is open to people with at least a diploma.	8
professionals	The target category is open to professionals of any sector.	3
NEET	The target category is represented by NEET (Not in Education, Employment, or Training).	1

The question raised by this observation is whether it could be making ECE limited to students who already have a strong background in a specific field. CE is understood as functioning more efficiently when stakeholders are all collaborating; however, it could be

assumed, therefore, that this reduces interaction and ECE accessibility between stakeholders who have different educational backgrounds.

Two main results were manually inserted as best practices: The “Junior Expert Course on Circular Economy” (JECE) (<https://centoform.it/portfolio/ifts-internazionale/> (accessed on 25 November 2022)) those coordinating institution is used as a case study in this paper, and a training course on CE for professors and lecturers to teach CE to others (<https://www.wikiscuola.eu/prodotto/economia-circolare-e-sostenibilita-ambientale-nelle-scuole-applicazioni-pratiche-e-laboratoriali/> (accessed on 25 November 2022)). The latter is an Italian 25 h asynchronous course. To our knowledge, it appears to be the only course training other professors/professionals so that they can teach ECE themselves.

When searching for the courses’ cost, it was not always provided or available. It was predictable that universities or larger, more renown, institutions that provided ECE could be more expensive (Appendix B). Generally, the costs depend upon the State’s policies for education financing. It was also noted that private and high specification courses, such as Masters, have high and potentially not accessible costs. Moreover, it was positive to note that, while costs could be a barrier, digital accessibility may not be. Most of the courses showed blended participation; therefore, it expands participation and potentially increases inclusivity. We make this statement acknowledging that at least in Europe there are still areas where digital divide is a concern, and the pandemic did not push for improvements [62]. Increased expenditure on higher education could compensate for this divide [63] additionally underlying the already acknowledged positive impact of efficient higher education.

Giannoccaro et al., (2021) [12] did find in Italy the existence of three master’s degrees and five postgraduate courses mentioning the words “Circular Economy” in the title. These results did not appear to us, suggesting that while CE is becoming a discipline on its own (12) not all courses are always discoverable.

It is relevant to note that the top results for Norway and Finland led to a dedicated institutional web portal for higher education in the respective countries. This method could be deemed an effective tool for future students, and more specifically CE students, providing a comparison tool based on ranking, precise information, field specialization, course modality, and cost. It is common for students to find it difficult to look for the right course only because it did not appear on the results, or to find private and expensive courses because these same institutions have more resources to promote themselves online.

An expected result is that ECE providers that are most known, such as HEI with renown reputations, would appear at the top of the search, and therefore, potentially also providers with more funding to build clearer and more SEO-powered websites. Therefore, other equally efficient ECE providers, who may not have enough funding or may not request any profit from the young students exactly so as to provide greater accessibility, could be left out. This issue could also reinforce the concept that HEI are the only ones potentially providing reputedly efficient, or educationally qualifying for the job market, ECE courses. Thus, while we do not know the answer to the latter, the former should be taken into consideration and resolved, as suggested indirectly in our recommendations.

4.2. Questionnaire Results

The respondents of the questionnaire (The questionnaire was shared via a google form: <https://forms.gle/fg8ZghVofgti7qGKA>) (Supplementary Materials) represent different stakeholders: a vocational and training center that also provide ECE (Centoform (<https://centoform.it/>) (accessed on 12 December 2022)), a private company applying CE strategies (Cyrkl (<https://cyrkl.com/>) (accessed on 12 December 2022)), and a consultant, material scientist, working in the field of CE (Ævolution (<https://www.aevolution.tech/>) (accessed on 12 December 2022)) (Table 3). The last two stakeholders have previously taught in an ECE.

Table 3. Respondents' characteristics. Respondents' point of view on CE.

Respondent	Company Type	Respondents' Role	Description Role	Years of Experience with CE
CF	Vocational Training Company	Director and Founder	Vocational and training courses	They do not work in the field of CE directly, but the vocational course proposes CE courses 21 years in the vocational industry
AE	Consultancy Company	CEO	Circular Design Consumer Goods	3
CY	Private Company	Country Manager (Italy)	Waste Management Industry	1 and $\frac{1}{2}$
Respondent	How is a CE approach helpful to you/your company?	Where do you see the biggest levers to incorporate a CE model? (e.g., supply chain, product design, consumer behaviour)	Looking into the future, where would you see an increasing number in a particular work environment/area related to CE?	
CF	In our opinion is very important to transfer to young and adult people knowledge and skills related to the application of circular economy to productive processes	Product design and supply chain	Industrial symbiosis—eco design	
AE	It is our key value proposition	Product design	In the educational and R&D area	
CY	The circular economy is the basic business model on which our main solutions are based. We aim to provide tools to facilitate the development of this economic model. We are particularly focused on finding closed loop recycling cases, facilitating reuse, and creating industrial symbiosis synergies.	I believe the biggest levers to incorporate a CE model are present in the production phase rather than in the consumption one. In the short term, the biggest opportunities are represented by the most immediate solutions that can be implemented, such as finding better recycling solutions, reusing by-products, and including secondary raw materials in the production process. Preventing waste is also implementable in the short term, often only by improving the efficiency in the waste management processes. In the long term, eco-design is fundamental to gain the most benefits. By carefully design a product and its components for each of the strategy that a CE model suggests, there are several economic, such as reduction and stability of costs of materials, reduction of waste management costs and a more efficient reuse of resources, but also environmental ones, such as reduction of extraction of resources, impacts from production and transport and reduction of waste. Companies that anticipate regulations that will force them to reduce their materials impacts will probably have bigger advantages.	Probably, I'd say it would be much more required to be an expert in product design. Waste management competences are already shifting, and it is needed to have a deep knowledge of CE principles in this sector, which is expected to grow in the next few years. Green procurement and green sourcing are also increasing, since companies are researching sources of materials which are sustainable and that can provide stable flows of recycled materials.	

The questionnaire was divided into an initial understanding of their perception of CE, perception of ECE and what they think about the most efficient ECE application and structure. The questionnaire was provided through open-end and a Likert scale (1 to 5 depicting level of agreement or quality) (To facilitate the paper's formatting, a shorten version of the company's name has been provided for graphs (Centoform = CF; Ævolution = AE; Cyrkl = CY)).

The first results already highlight that stakeholders do reflect differently about ECE, while agreeing that collaboration could provide more clarity for ECE. Justified by the complexity of the topic of CE [11,26] and the challenges that come with constructing or synthetically explaining CE processes, also in education [51], the replies do highlight a focus on the production process. Nonetheless, this diverse understanding might be leading to opposing course structure methodologies being created, leading to further divergence.

4.2.1. Centoform (CF): Training Center Point of View (Pov)

Centoform is an accredited institution operating in different contexts such as Emilia Romagna and other regional areas together with European Union, Universities and Research centers. It provides higher and compulsory education, continuous learning, inclusion, apprenticeship, and employment services. It is also authorized by the Emilia Romagna Region to perform intermediation, research, and selection. In 2020, it designed a specific IFTS training course in CE called “Junior Expert in Circular Economy” (JECE), a one-year course of 800 h. This amount of time is divided into 480 h of interactive classes with the participation of academic and business professionals from local and international realities and 320 h of internship. The course has faced a couple of editions since 2020, with different admission requirements for educational level (mixing professionals, as well as only diploma holders) and place of residence. It has always been tuition free, with the main aim to train and support future CE experts. The tuition is free due to the institution’s partnership with the Italian Region Emilia Romagna and other co-operators, such as Universities, via EU funding, the objective of which is to provide ECE.

4.2.2. Cyrkl (CY): Private Sector Pov

Cyrkl is an international green-tech operating as a B2B e-commerce platform for industrial symbiosis. It applies CE principles to waste management through innovative technologies, data analysis, and machine learning. In 2022, the company won two awards in the program “Technology Fast 50” (Technology Fast 50 2022 ([deloitte.com](https://www.deloitte.com)) (accessed on 15 December 2022)) by Deloitte dedicated to the fastest growing European green tech companies. It has been described as the biggest European player in its sector.

4.2.3. Ævolution (AE): Consultant Pov

Ævolution is a consultancy and circular product design agency that provides innovative and circular material solutions in many sectors, especially sports, automotive, and construction sectors. It focuses especially on composite materials, polymers, and natural fibers. They provide solutions with innovative materials and complete circular design thinking, delivering products that can be re-entered in the technical loop.

It should be noted that both Cyrkl and Ævolution have focused their professional interest in CE and have collaborated with Centoform as lecturers to specific classes available during JECE.

4.2.4. Perceptions on ECE

As observed in Table 3, product design was deemed CE’s main lever. ECE focusing on a particular field or role was also identified in the conceptual framework. ECE focusing on a particular field can be understood because of facilitating ECE since CE is deemed a complex topic to translate into concrete skills. However, it may result in providing unclear and limiting professional roles, since in practice other skills are required. Similar observations are recorded when respondents are asked about the potentially ideal CE expert.

The results (Figure 3) highlight the observed disagreement among the respondents on what a CE expert could be. While we are aware that this analysis is not looking to provide a trend, it is curious to observe the disagreement between results even when a CE expert is described as someone with partial knowledge of all the previous options listed.

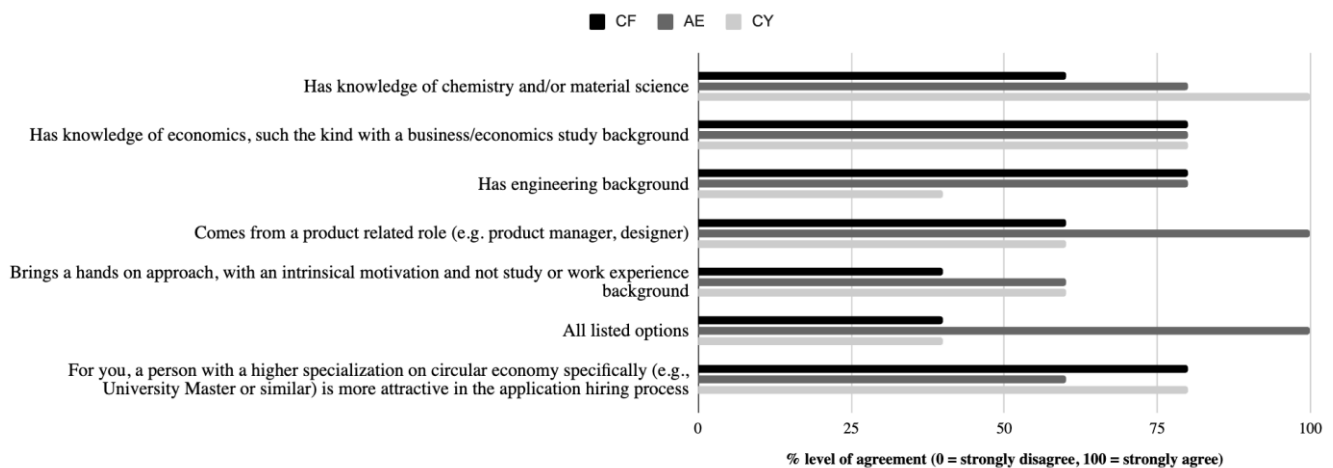


Figure 3. Ideal CE expert according to the respondents (% agreement level).

The only description that all respondents agreed on was that a CE expert is one that should also have knowledge of economics, such as one with an economics degree. A result that is supported in the literature is presented in this paper. Additionally, confirming that collaboration for ECE is suggested between various disciplines [64], but also within (and among) sectors [65]. Furthermore, Williams et al., (2018) [40] identify that ECE requires collaboration even between educational institutions and external organizations. Thus, the focus on an economics background could be an indication that CE strategies also require an understanding that goes beyond specific professional roles, potentially challenging the previously presented “CE manager” [12]. There is a distinct difference between the replies between CF and the other two respondents. These differences could not only lie in the choice of modules, but also in the responsibility determined by the source of any training opportunities.

If firms provide the training and development opportunities, their modules may not reflect those provided by external training facilities that are actually the ones preparing young professionals to enter the labour market or it is simply reserved to their employees without looking to new employment. This could result in a skills mismatch between those acquired by youth via potential training or educational pathways, and those desired by companies. If firms are re-training or training their employees (of any age) without providing access to a newer labour force, it could provide a higher level of exclusions for younger professionals looking to enter specific firms. The following could be a relevant note if we consider that in Western economies, youth unemployment is generally higher than the overall unemployment rate and more sensitive to the business cycle with a national competence [66].

As expected, these differences are observed in the diverse requirements expected from a CE professional. In fact, the skills they list are diverse from each other. CY highlights (Table 4) the needed ability to think of CE systemically. Similar (diverse) skills were also identified in previous research [22].

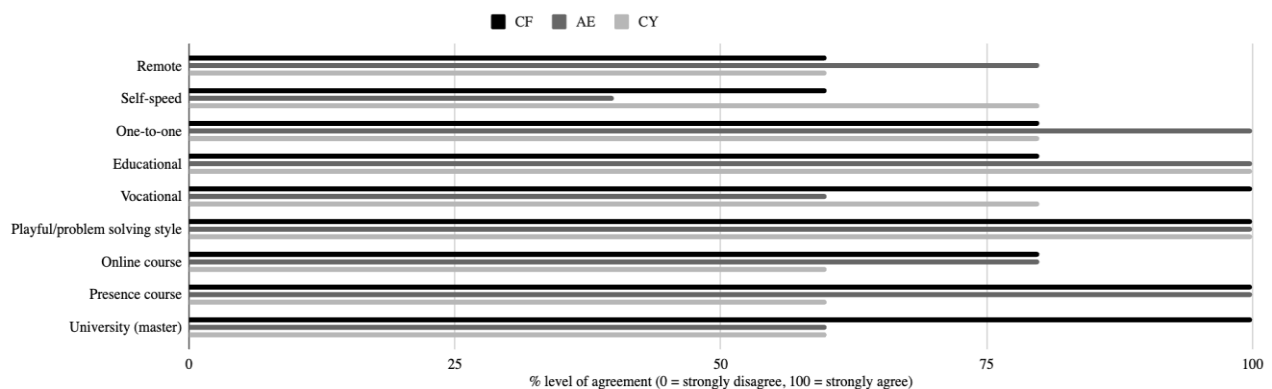
A further divergence in agreement between stakeholders on required skills could lead to increased challenges for youth, if we consider that there are additional indirect factors, to take into consideration, that could affect job performance, such as Intelligence Quotients (IQ) and Emotional Quotients (EQ) [67].

Table 4. The skills required for a CE professional.

Respondent	Which Is Your Ideal Role Description of a Circular Economy Professional? (You Can Type in Keywords and Soft Skills)
CF	Soft skills: creativity, teamworking, open mind knowledge and skills about project management. Some knowledge and skills about energy efficiency, eco design and new business models, carbon footprint, LCA, Industrial symbiosis approach, economic and social impact.
AE	System thinking approach, analytical mind, product design background combined with business skills (understanding).
CY	It depends a lot on the role, which can be very different. In our case, when we consult companies on how to implement circular economy in their processes, we need competences such as: knowledge of materials, regulations, production processes, circular economy principles, but also ability to research and present the right information, to create networks. It is needed the ability to think circularly, which means to be able to understand each production flow or product and find the best economic and environmental solution for that one, as suggested from the theory of the CE.

4.2.5. ECE Form and Platforms for Knowledge Transfer

In the final section of the questionnaire, the respondents provide their perception of the best forms and platforms to provide CE knowledge transfer. While most of the ECE forms (vocational, university, master and so forth) were deemed the best for CE knowledge transfer (Figure 4), there was a difference between what CF replied compared to AE and CY. It appears that the CE experts' opinions differ, also when observing these variables, from the vocational institution—that is, providing ECE. Thus, these appear to be a preliminary highlight that agreement should exist not only for what is taught when transferring knowledge on CE, but also the form in which this occurs.

**Figure 4.** Respondents' likability platforms for ECE knowledge transfer and forms of knowledge transfer (% agreement level).

The differences previously mentioned were not necessarily observed in the mode of knowledge transfer (Figure 4); however, they were observed in the modularity, experience requirements, and course length (Figure 5). In fact, while AE and CY agreed that shorter courses and experience could provide more effective knowledge transfer, CF did not agree.

The authors can only surmise the motivations behind these responses, as a more in-depth questionnaire would be required to fully ascertain them. Nonetheless, it is apparent that the domain of CE involves a diverse array of professionals and fields, necessitating broad collaboration to comprehend the obstacles within the educational sphere and academia, as well as the requirements of the employment market and corporations.

It appears that the only agreement for these categories is problem-solving. Certainly, in view of the CE complexity, which is required by various transitioning industries and sectors, being able to resolve problems is expected.

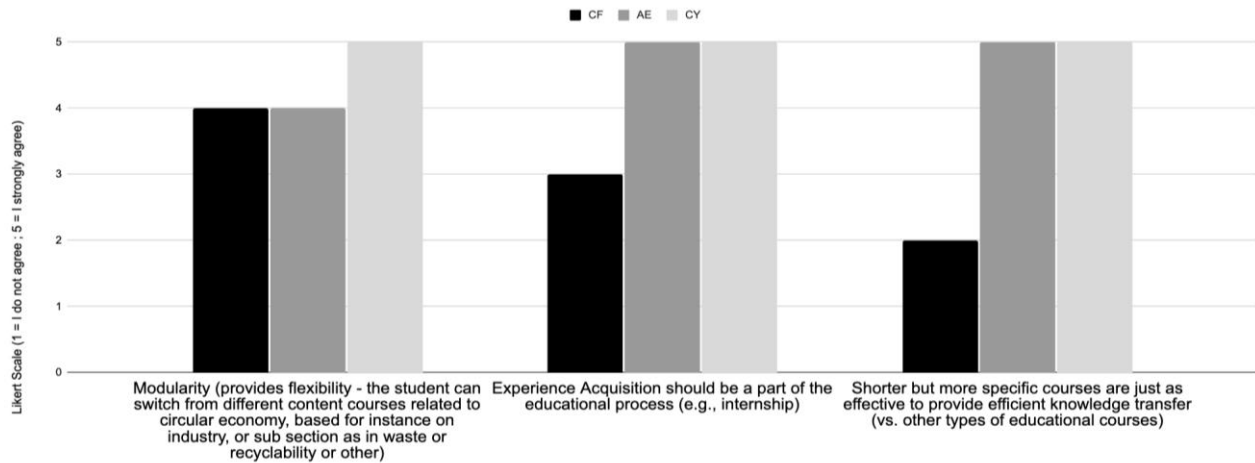


Figure 5. Additional respondents' perception on ECE requirements (modularity, length, and experience acquisition opportunities) (% agreement level).

However, divergence was observed in terms of the delivery mode of CE courses. The possibility of offering CE courses online and remotely may become a limiting factor. Additionally, while the CE experts (AE and CY) thought that an educational format, compared to vocational, was more prominent for a ECE, potentially leading to a divergence between labour demands and educational training modules offered. Furthermore, vocational courses are provided to NEET [68] and a reduction in these opportunities, since ECE are deemed increasingly effective in alternative educational context, could increase social inequality not only for minors who may choose for various reasons not to pursue a traditional University curriculum, but for young professionals who may wish to change their careers and retrain. The absence of analysis and regional data collection in this regard could challenge the policy-making process in the green transition that dictates labour markets and skills building [4].

4.2.6. ECE Limitations and Opportunities

The difference in perception is also quite visible in regard to the course length and modularity.

The main ECE barriers (Table 5) viewed by the respondents are: the advantages of CE application are not always clear even by ECE lecturers, ECE has interdisciplinary requirements, CE requires specific skills, and the potential absence of first-hand experience in ECE leads to little understanding of CE strategy applicability. The respondents have positive opinions about the ECE regulation and standardization by institutions, though this may not represent the final solution, especially if we consider that in the case of youth, unemployment remains a national matter, while still affecting most of Europe [29]. This also represents an open window for further specifications, paths, and customization of the courses, with the involvement of companies and practical and circular reasoning, if we take into consideration the expansion of ECE in multiple educational systems.

Table 5. Respondents' perception on ECE barriers and potential standardized EU toolkit.

Respondent	Which Do You Think Are the Current Limitations in Expanding/Sharing Circular Economy Knowledge Transfer?	Which Do You Think Are the Current Limitations in Constructing Opportunities for Circular Economy Education?	Would You Find It Beneficial to Regulate or Provide a Central Outline/Toolkit for Circular Economy Education (by the EU or Member State Regulator)? If Yes, Please Provide Explanations.
CF	We need to highlight all the advantages of circular economy. Not only environmental sustainability but also economic and social advantages	Many teachers don't know what circular economy really means and the related opportunities	It could be useful but it's not enough. Interdisciplinary approach is fundamental. Very important is also the involvement of companies/organization as best practices
AE	Limited amount of best practice example and generally adopted standards	Required skillsets vary often based on specific project or industry challenges	Yes, because it will help standardizing concepts but would still leave room for diversification regarding specific industry related skillsets
CY	To expand and share the CE knowledge, it's necessary to face more the reality by attempting to apply the theory in specific business cases. At this level of application, it would likely be possible to understand barriers more deeply. To do so, concepts and advantages of CE need first to be fully understood by the industries, therefore one of the first approach to ensure further common knowledge is to advocate for CE.	CE needs to be applied. A CE model, as explained in the theory, is a perfect way to handle resources. There are several reasons I believe that limits its application, which can be summarized in the following ones: knowledge of this possibility, understanding of its benefits and the case-specific difficulties of each context. By applying it more, more successful solutions can be found and shared, therefore increasing the interest towards this model and a more solid knowledge base of solutions and strategies.	Absolutely yes. I believe CE needs to be included in every educational system in European member states to provide the tools to every person to think circularly, e.g., understanding the impacts of the goods they buy and use, to make consumption choices more responsibly and to create competencies to face one of the major challenges of our time: the use and impacts of materials.

5. Limitations

The main limitation of this study is its preliminary nature, which is constrained by limited data, thus providing only initial insights and recommendations. Moreover, the questionnaire (Supplementary Materials) used in the study only offers a perspective on the case studies and specific stakeholder roles in ECE and CE applications, rendering it limited to representative stakeholders. Despite these limitations, we have used the results to potentially confirm or highlight ECE barriers and opportunities discovered through the literature review.

The objective of this study is to clarify and emphasize the importance of ECE, as it will play a crucial role in training future young professionals to acquire the required skills that are needed and accessible for the environmental transition. Although the VPN search provided some insights into digital inclusivity, variations in users' chosen keywords and other variables influenced by search engine optimization (SEO) rules and algorithms could limit its reliability. In fact, for this reason, we purposely excluded results from paid advertisements. Furthermore, the clarity and SEO potential provided by a website could be an indication of an institution or educational authority providing the ECE course, time and resources available to create an adequate and effective website and communication products.

6. Recommendations (Phase 4)

Resulting from an analysis of the current literature review on ECE and the case studies, we propose recommendations for revisiting ECE, in view of ECE's impact not only on the efficient application of CE strategies, but also on rendering it accessible to increase youths' chances in an everchanging market to enter the labour force with the correct set of skills and aptitude:

6.1. *Standardize (or Find Common Grounds) among and for Different Stakeholders in ECE*

Standardization would provide a clearer view of the objectives necessary to accomplish successful ECE and what it entitles. Furthermore, it would clarify the expectations for younger professionals when looking into jobs within the CE field, as well as expectations for firms hiring. If applied on a wide scale, it could be a tool for general awareness and circular thinking that starts from the consumer and spans over to the private and public sector, creating a two-sided communication and involvement.

6.2. *Provide a Benchmark and Key Performance Indicator*

Providing a benchmark might facilitate the argument concerning the requirements to access ECE, the most efficient modality and form, as well as the expected outcomes in the ever-changing job market.

6.3. *Acknowledge the Disagreements and Encourage Interdisciplinary Collaboration*

CE requires interdisciplinary collaboration first. The acknowledgment of disagreements can be a starting point to analyse the real requirements of a professional working in CE-related jobs and activities, this can be performed only through proper communication and collaboration between different fields of work and sectors.

6.4. *Provide Clearer Indications of Future Opportunities and GJ Required*

This option can be best provided if institutions will start to focus on public awareness through awareness programs, events, social media campaigns, and so forth. The private sector's actions and partnerships are crucial to represent a window to real-world experience and show the already existing solutions and advantages.

6.5. *Increase Training Opportunities and Clear ECE Advantages at National Level*

Since CE is a multidisciplinary and complex field, it is important to both provide specific courses about circular management and education and incorporate circular economy principles into the existing curriculum (e.g., existing subjects, such as business, engineering, and environmental studies).

ECE opportunities should not be confined to young students, but also to experienced professionals and adults. Both on-campus and online options should be provided. This recommendation also includes practical working opportunities that can help students to upskill faster and more efficiently together with the strengthening of newly trained CE employees and major industrial sectors. Ultimately, this will improve social-economy conditions. Faster and shorter courses could be a tool to speed up specific knowledge gaps or as periodical updates. If shorter courses are deemed not enough to provide the required knowledge transfer, they should be formed in such a way that they provide further upskill and enough to access experience acquisition opportunities.

6.6. *Support from Educational Institutions or Governments in Providing Funding for ECE and Research Projects on Materials Circular Management That Can Facilitate Access to GJ*

ECE's basic principles should be accessible to any European member. Increased investment in research could resolve nowadays issues about material circularity and sustainable supply chains, finally start to implement new solutions, starting to fill the existing gaps in the needed fields.

7. Conclusions

The aim of this paper was to discuss the current state of ECE and to identify any gaps or areas for improvement acknowledging the increase of GJ and knowledge requirements to efficient CE application. To thoroughly assess this objective, the current literature review on ECE and GJ was analysed. Current ECEs were identified via a web search from various European locations by using a VPN, and results from a questionnaire were provided highlighting the opinions of three stakeholders in this field.

The recommendations proposed in the study include standardizing ECE objectives among stakeholders, providing a benchmark to facilitate access to ECE, acknowledging disagreements and encouraging interdisciplinary collaboration. This can provide clearer indications of future opportunities and knowledge requirements, increasing training opportunities at the national level, and supporting funding for ECE and research projects on materials circular management. These recommendations aim to increase efficient application of CE strategies, foster inclusivity, and avoid potential socioeconomic barriers for young generations entering the job market in an ever-changing field.

Being able to efficiently disseminate CE principles, there has been a noted positive response towards the standardization of ECE, which could be applied at the public level and then augmented through specialized training for professionals and students across a range of fields. However, the expansion of ECE cannot occur without an increase in funding to provide more training opportunities and investment in research to create a virtuous cycle aimed at closing the current gap in the circular economy. As shown in Section 4.1, countries with a stronger CE also had more internet search results.

The results provided by the questionnaire highlighted the validity of the results provided by the literature, showing that stakeholders do not find similar stands in the CE knowledge transfer. This mismatch is observed also when questioned about an ECE EU toolkit, therefore underlying that potentially it could be challenging even for policymakers to find common ground among varying points of views and expectations for this objective that if instead reinforced could provide not only an overall increase in the number of jobs for the younger generation, who would have access to training opportunities, but those in particular rural areas, thus providing a social value.

Our recommendations try to provide a standardized, collaborative, and transparent approach to ECE to avoid dissent, close the distance between stakeholders, and increase proactive communication. It requires more attention to GJs' labour demand and access requirements via ECE indirectly pressuring countries to collect regional data, reduce the potential digital divide, and reduce the risk of increased youth unemployment in this field.

Ultimately, the next step could be to create a roadmap for building a strong and effective ECE foundation to nurture a new generation of leaders and practitioners capable of driving the transition to a more sustainable and resilient future that is supported by policies.

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/youth3020038/s1>.

Author Contributions: Conceptualization A.G., L.P. and F.H. Methodology, A.G., L.P. and F.H.; software, L.P. and A.G.; formal analysis, A.G., L.P. and F.H.; resources, A.G., L.P. and F.H.; data curation, A.G., L.P. and F.H.; writing—original draft preparation, A.G., L.P. and F.H.; writing—review and editing, A.G., L.P. and F.H.; visualization, A.G. and L.P. All authors have read and agreed to the published version of the manuscript.

Funding: The author(s) received no financial support for the research, authorship, and/or publication of this article.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available in Appendices A and B and Supplementary Materials.

Conflicts of Interest: The authors declare no conflict of interest. The respondents of the questionnaire had no role in any of the steps involved for writing, drafting, and publishing this research.

Appendix A

Table A1. Main points from the 37 papers selected for review analysis.

Main Point	Reference
Introduce students to the CE concept without focusing on a specific CE aspect, such as design.	Kirchherr, J., and Piscicelli, L. (2019) [18]. “Towards an Education for the Circular Economy (ECE): Five Teaching Principles and a Case Study”. <i>Resources, Conservation and Recycling</i> , 150, 104406. https://doi.org/10.1016/j.resconrec.2019.104406
Materials and techniques for a three-level education framework will be often updated and more flexible to meet the needs of sustainable development. The feedback of education and training should be more formal and timelier, and the education should be more systematic.	Gao, C., Hou, H., Zhang, J., Zhang, H., and Gong, W. (2006) [27]. “Education for regional sustainable development: experiences from the education framework of HHCEPZ project”. <i>Journal of Cleaner Production</i> , 14(9–11), 994–1002. https://doi.org/10.1016/j.jclepro.2005.11.043
Encourage researchers and academics to respond to emerging needs by re-thinking education in design and engineering.	De los Rios, I. C., and Charnley, F. J. (2017) [33]. “Skills and capabilities for a sustainable and circular economy: The changing role of design”. <i>Journal of Cleaner Production</i> , 160, 109–122. https://doi.org/10.1016/j.jclepro.2016.10.130
A sufficient number of professionals (quantity) with the right competences (quality) is needed to make the transition to a circular economy happen. The results show that transversal competences and valorisation competences are equally important as technical competences for a CE.	Janssens, L., Kuppens, T., and Van Schoubroeck, S. (2021) [22]. “Competences of the professional of the future in the circular economy: Evidence from the case of Limburg, Belgium”. <i>Journal of Cleaner Production</i> , 281, 125365. https://doi.org/10.1016/j.jclepro.2020.125365
Suggests firms to: (1) engage in green education, (2) create community, (3) be aware of consumer diversity, and (4) not differentiate by gender. University education may greatly influence students’ mindset concerning sustainable behaviour.	Prieto-Sandoval, V., Torres-Guevara, L. E., and García-Díaz, C. (2022) [53]. “Green marketing innovation: Opportunities from an environmental education analysis in young consumers”. <i>Journal of Cleaner Production</i> , 363, 132509. https://doi.org/10.1016/j.jclepro.2022.132509
Political, economic, and environmental awareness as well as technological skills have been chosen as barriers. Consequently, they chose to invest in education and research, noticing the citizens/society as the main agent of transformation. Since the challenge is to find organized and progressive steps to build interactions, programs, actions, and legislation to favour the integral (between sectors) and internal (within a sector) transition, indicators for monitoring as well as policies, priorities and perspectives have been highlighted to contribute to boost the transformation towards a circularity approach.	Rótoló, G., Vassillo, C., Rodriguez, A., Magnano, L., Milo Vaccaro, M., Civit, B., Covacevich, M., Arena, A., and Ulgiati, S. (2022) [65]. “Perception and awareness of circular economy options within sectors related to agriculture in Argentina”. <i>Journal of Cleaner Production</i> , 373, 133805. https://doi.org/10.1016/j.jclepro.2022.133805
ESD is fragmented by different approaches, issues, methodologies, and implications, lacking a consistent body of knowledge. Some courses focus more on the social dimension, while others are more directed to the Environment or the Economic one. Sometimes the chosen approach is more normative (do what is right to do; the ethical way) and in other cases it is more instrumental (do what is good for the business; the business case).	Fonseca, L. M., Portela, A. R., Duarte, B., Queirós, J., and Paiva, L. (2018) [46]. “Mapping higher education for sustainable development in Portugal”. <i>Management & Marketing</i> , 13(3), 1064–1075. https://doi.org/10.2478/mmcks-2018-0023
Collaboration between universities and external organizations offers opportunities for multiple and mutual benefits, including the development of employability skills in students.	Williams, I., Roberts, K., Shaw, P. J., and Cleasby, B. (2018) [40]. “Applying circular economy thinking to industry by integrating education and research activities”. <i>Detritus</i> , 1(1), 134. https://doi.org/10.26403/detrutus/2018.11
Sustainability should be discussed among all educational fields (economists, political scientists, and so forth). Similarly, this should be performed for ECE.	Tetiana, H., and Malolitneva, V. (2020) [64]. “Conceptual and Legal Framework for Promotion of Education for Sustainable Development: Case Study for Ukraine”. <i>European Journal of Sustainable Development</i> , 9(2), 42–54. https://doi.org/10.14207/ejsd.2020.v9n2p42
Professionals, as designers, must be properly trained so that the concept of CE is properly understood and applied.	Leube, M., and Walcher, D. (2017) [52]. “Designing for the next (Circular) Economy. An appeal to renew the Curricula of Design Schools”. <i>The Design Journal</i> , 20(sup1), S492–S501. https://doi.org/10.1080/14606925.2017.1352999
A circular economy in the energy sector is expected to contribute, inter alia, to improvement of energy use and reduction of greenhouse gas emissions. The application and implementation of the related assumptions are largely dependent on general education, but also on specialist education. The level of concentration of student education in the fields of electricity and energy has not changed significantly.	Rokicki, T., Perkowska, A., Klepacki, B., Szczepaniuk, H., Szczepaniuk, E. K., Bereziński, S., and Ziółkowska, P. (2020) [39]. “The Importance of Higher Education in the EU Countries in Achieving the Objectives of the Circular Economy in the Energy Sector”. <i>Energies</i> , 13(17), 4407. https://doi.org/10.3390/en13174407
Students who have been taught about public–private partnership models at university are more likely to recognise certain misconceptions about public–private partnerships and are more likely to think that it is possible to successfully implement such projects (e.g., energy projects in Croatia were the case study of the paper).	Bogovac, J., Dodig, D., and Lugarić, T. R. (2021) [50]. “Public-Private Partnership and Circular Economy—What Croatian Students Learn at University”. <i>Energies</i> , 14(11), 3261. https://doi.org/10.3390/en14113261
The validity and necessity of continuous education in eco-responsible citizenship has thus been confirmed.	Sukiennik, M., Zybała, K., Fuksa, D., and Kęsek, M. (2021) [54]. “The Role of Universities in Sustainable Development and Circular Economy Strategies”. <i>Energies</i> , 14(17), 5365. https://doi.org/10.3390/en14175365
The results show that businesses with activities related to the Circular Economy are more likely to survive over extended periods of time.	Uribe-Toril, J. (2022, January 6) [2]. “The Circular Economy and retail: using Deep Learning to predict business survival—Environmental Sciences Europe”. SpringerOpen. https://enveurope.springeropen.com/articles/10.1186/s12302-021-00582-z

Table A1. Cont.

Main Point	Reference
This study confirms the potential of using active learning for empowering students with knowledge and skills for sustainability during a materials education workshop.	Kioui, V., Vakhitova, T. V., and Whalen, K. A. (2021) [32]. "Active learning as enabler of sustainability learning outcomes: Capturing the perceptions of learners during a materials education workshop". <i>MRS Energy & Sustainability</i> , 9(1), 64–78. https://doi.org/10.1557/s43581-021-00019-3
Learning and creating multiple values to increase social–ecological value, complementarity to economic value, necessitate activating the complexity of value embedded in digital education and circular economy transitions with customizable niches of learning preferences and journeys of individuals and groups, within broader (and evolving) technological, organizational, and institutional structures.	Türkeli, S., and Schopphuizen, M. (2019) [38]. "Decomposing the Complexity of Value: Integration of Digital Transformation of Education with Circular Economy Transition". <i>Social Sciences</i> , 8(8), 243. https://doi.org/10.3390/socsci8080243
The higher education system plays a critical role in supporting the transition towards a circular economy (CE).	Giannoccaro, L., Ceccarelli, G., and Fraccascia, L. (2021) [12]. "Features of Higher Education for the Circular Economy: The Case of Italy". <i>Sustainability</i> , 13(20), 11338. https://doi.org/10.3390/su132011338
The results of the game workshops demonstrated that the game advanced the participants' awareness of the need for a circular economy, their understanding of basic circular economy principles, and their insight in opportunities and challenges of circular business models at the company level.	Manshoven, S., and Gillabel, J. (2021) [34]. "Learning through Play: A Serious Game as a Tool to Support Circular Economy Education and Business Model Innovation". <i>Sustainability</i> , 13(23), 13277. https://doi.org/10.3390/su132313277
Projects provide learning not only for students, but also the case study firm and give tangible outputs in terms of new value-generative products in the CE transition.	Whitehill, S., Hayles, C. S., Jenkins, S., and Tylour, J. (2022) [37]. "Engagement with Higher Education Surface Pattern Design Students as a Catalyst for Circular Economy Action". <i>Sustainability</i> , 14(3), 1146. https://doi.org/10.3390/su14031146
Increasing awareness of environmental education and initiating participatory environmental programs and strengthening 3 of the key sustainability competencies is recommended as an effective tool to transition to a circular economy in the institution. Further studies are recommended in areas of gamified learning for CE and capital generation from waste for capacity building.	Owojori, O. M., Mulaudzi, R., and Edokpayi, J. N. (2022) [51]. "Student's Knowledge, Attitude, and Perception (KAP) to Solid Waste Management: A Survey towards a More Circular Economy from a Rural-Based Tertiary Institution in South Africa". <i>Sustainability</i> , 14(3), 1310. https://doi.org/10.3390/su14031310
Architects and urbanists help to shape the built environment, which is both highly impactful and indispensable to support the sustainable development of any society. Hence, they must not only have a basic understanding but also be trained to routinely incorporate sustainability checks into their design practice.	Gomes, V., da Silva, M. G., and Kowaltowski, D. C. C. K. (2022) [41]. "Long-Term Experience of Teaching Life Cycle Assessment and Circular Design to Future Architects: A Learning by Doing Approach in a Design Studio Setting". <i>Sustainability</i> , 14(12), 7355. https://doi.org/10.3390/su14127355
HEIs can play an essential role in promoting environmental education and creating partners with new visions for society and the economy concerning sustainability, developing knowledge, values, attitudes, and behaviors behaviours regarding the CE.	Deda, D., Barros, M. V., Rigueiro, C., & Ribau Teixeira, M. (2022b) [11]. "From Linear to Circular Ideas: An Educational Contest". <i>Sustainability</i> , 14(18), 11207. https://doi.org/10.3390/su141811207
The CE concepts and principles and their relationship to sustainability implementation require reinforcement and transversal approaches to increase this knowledge and its dissemination.	Wandl, A., Balz, V., Qu, L., Furlan, C., Arciniegas, G., & Hackauf, U. (2019) [6]. "The Circular Economy Concept in Design Education: Enhancing Understanding and Innovation by Means of Situated Learning". <i>Urban Planning</i> , 4(3), 63–75. https://doi.org/10.17645/up.v4i3.2147
CE can be accelerated through the implementation of greener forms of innovation.	Rao, H., Chen, D., Shen, F., & Shen, Y. (2022) [10]. "Can Green Bonds Stimulate Green Innovation in Enterprises? Evidence from China". <i>Sustainability</i> , 14(23), 15631. https://doi.org/10.3390/su142315631
Firms' green knowledge transfer in opportunities are meant to tackle those missouts of a State's educational system, including extending green awareness within the company.	Napathorn, C. (2021) [35]. "The development of green skills across firms in the institutional context of Thailand". <i>Asia-Pacific Journal of Business Administration</i> , 14(4), 539–572. https://doi.org/10.1108/apjba-10-2020-0370
There is growing interest in CE; however, to be able to gain the positive outcomes of implementation of CE strategies, efficient knowledge but must be acquired.	Darmandieu, A., Garcés-Ayerbe, C., Renucci, A., & Rivera-Torres, P. (2021) [3]. "How does it pay to be circular in production processes? Eco-innovativeness and green jobs as moderators of a cost-efficiency advantage in European small and medium enterprises". <i>Business Strategy and the Environment</i> . https://doi.org/10.1002/bse.2949
There is a lack of uniform methods for measuring and forecasting the effects of Green Jobs creation and indicates future research directions.	Sulich, A., & Sołoduch-Pelc, L. (2021) [14]. "The circular economy and the Green Jobs creation". <i>Environmental Science and Pollution Research</i> , 29(10), 14231–14247. https://doi.org/10.1007/s11356-021-16562-y
CE will lead to increasing GJs and a green economy.	Rahigude, R., Khwairakpam, D., Rade, S., & Kadam, K. (2022) [47]. "Construction waste management in the context of de-tools, industry 4.0 & circular economy, a critical review of pune metropolitan area, India". <i>International Journal of Sustainable Building Technology and Urban Development</i> , 13(4), 514–548. https://doi.org/10.22712/susb.20220037
No workers dedicated to "green jobs" is strongly correlated to the probability of adopting resource-efficiency practices, while perceiving the need of extra environmental skills has a positive effect on the intention to implement actions in the future. Other characteristics of the firms play a significant impact on resource efficiency: in general, older and bigger firms, with larger yearly turnover, are more prone to implement actions.	Bassi, F., & Guidolin, M. (2021) [29]. "Resource Efficiency and Circular Economy in European SMEs: Investigating the Role of Green Jobs and Skills". <i>Sustainability</i> , 13(21), 12136. https://doi.org/10.3390/su132112136
Larger firms have a higher probability to be in the group of firms with green jobs. Firms' technological capabilities, openness to external sources of knowledge, and green products and services specialization are crucial not only for the probability, but also for having a greater number of green jobs.	Moreno-Mondéjar, L., Triguero, Á., & Cuerva, M. C. (2021) [30]. "Exploring the association between circular economy strategies and green jobs in European companies". <i>Journal of Environmental Management</i> , 297, 113437. https://doi.org/10.1016/j.jenvman.2021.113437

Table A1. Cont.

Main Point	Reference
The most effective of the selected alternatives in the circular economy model in the field of separate collection and recycling of waste can be achieved via measures exercised by green enterprises, followed by green jobs and finally- the role of environmentally sound activities taken by the public.	Vesere, R., Kalnins, S. N., & Blumberga, D. (2020) [45]. "Role of Green Jobs in the Reduction of Waste and Waste Management". <i>Environmental and Climate Technologies</i> , 25(1), 1128–1141. https://doi.org/10.2478/rtuct-2021-0085
Skills in waste management are not all the same and green jobs must take such notion into consideration.	Liu, Y., Park, S. J., Yi, H., & Feiock, R. C. (2019) [42]. "Evaluating the employment impact of recycling performance in Florida". <i>Waste Management</i> , 101, 283–290. https://doi.org/10.1016/j.wasman.2019.10.025
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.	Phung, C. G. (2019) [28]. "Implications of the circular economy and digital transition on skills and green jobs in the plastics industry. Field Actions Science Reports". <i>The Journal of Field Actions</i> , 100–107. https://journals.openedition.org/factsreports/pdf/5498
Specific education and training programs for future development of the CE are required.	Burger, M., Stavropoulos, S., Ramkumar, S., Dufourmont, J., & Van Oort, F. (2019) [26]. "The heterogeneous skill-base of circular economy employment". <i>Research Policy</i> , 48(1), 248–261. https://doi.org/10.1016/j.respol.2018.08.015
Labour use increases are observed for very large farms which that adopted green measures.	Unay-Gailhard, I., & Bojnec, Š. (2019) [44]. "The impact of green economy measures on rural employment: Green jobs in farms". <i>Journal of Cleaner Production</i> , 208, 541–551. https://doi.org/10.1016/j.jclepro.2018.10.160
Efficient application of CE strategies can help reduce poverty and this requires access to specific employment and forms of entrepreneurship directed to these forms of green innovation.	Conlon, K., Jayasinghe, R., & Dasanayake, R. (2018) [25]. "Circular economy: waste-to-wealth, jobs creation, and innovation in the global south". <i>World Review of Science, Technology and Sustainable Development</i> , 15(2), 145. https://doi.org/10.1504/wrstd.2019.099377
Education of sustainability is also required to increase attention to alternative values within the company that goes beyond attention to profit.	Vischi, A. (2018) [36]. "Sustainability and Education. Innovation Technology, Green Jobs, Generative Enterprises". <i>Encyclopaedia</i> , 22(50), 67–78. https://doi.org/10.6092/issn.1825-8670/7923
CE business model innovations as an instrumental mechanism for an efficient use of resources and enhanced sustainability performance. There is a lack of leadership in this field and institutions, such as Universities, lack the access to appreciate decision-support frameworks and key performance indicators.	Mendoza, J. M. F., Gallego-Schmid, A., and Azapagic, A. (2019) [31]. Building a business case for implementation of a circular economy in higher education institutions. <i>Journal of Cleaner Production</i> , 220, 553–567. https://doi.org/10.1016/j.jclepro.2019.02.045

Appendix B

The characteristics of the VPN: (1) encrypts data to protect user privacy, (2) hides the user's IP address to maintain anonymity online, (3) allows the user to access restricted or blocked content, and (4) can be used to secure public Wi-Fi connections.

VPN's technical features: (1) uses strong encryption protocols, such as OpenVPN or IKEv2/IPSec, (2) offers a kill switch to protect the user's data if the VPN connection drops, (3) has a no-logs policy to protect user privacy, (4) offers a variety of server (500 for SurfShark) locations to allow the user to choose the best connection for their needs, and (5) offers a secure, reliable connection with minimal downtime or connection issues.

Table A2. Summary and technical features using VPN (Surf Shark).

Typed Words	Country (IT = ITALY; SP = SPAIN; GR = GREECE; FR = FRANCE; HU = HUNGARY; FI = FINLAND; NO = NORWAY; DE = DENMARK; GE = GERMANY)	Vpn Location	Total Results	Course Type	Course Target	Modality	Price	Status	URL (The “URL” Column Collects the Top Result from the Given Research.)
corso in economia circolare	IT	Rome	6,120,000	university	relevant studies access	on campus	Up to 1.99807 EUR	open	DEIM-ECONOMIA— Presentazione (https://www.unitus.it/it/dipartimento/deim-economia/economia-circolare-econ-deim/articolo/economia-circolare-econ-deim1)
corso in economia circolare	IT	Bologna	6,034,000	vocational	diploma	blended	free	closed	https://centoform.it/portfolio/ifts-junior-expert-in-circular-economy-2022-2023/
corso in economia circolare	IT	Rome	6,120,000	vocational	professionals	online	120 EUR	open	https://www.wikiscuola.eu/prodotto/economia-circolare-e-sostenibilita-ambientale-nelle-scuole-applicazioni-pratiche-e-laboratoriali/
circular economy course	IT	Rome	36,800,000	miscellaneous	diploma	blended	600-19,000 EUR	open	Circular Economy Courses Ellen Macarthur Foundation
curso de economía circular	SP	Madrid	7,050,000	introductory	diploma	blended	free	open	modelo circular, oportunidades para las empresas—Módulo 1 · Pacto Mundial
circular economy course Spain	SP	Madrid	11,200,000	university	relevant studies access	blended		open	Master Universitario en Economía Circular—Campus Iberus
μάθημα στην κυκλική οικονομία	GR	Athens	190,000	university	relevant studies access	on campus		open	Studi—Master in Gestione sostenibile dei cambiamenti ambientali e dell'economia circolare [ViDiPAKO] TMMXPPA-UTH
circular economy course Greece	GR	Athens	5,830,000	vocational	NEET	blended	free	closed	HELIOS in Greece opens registration for course on blue and circular economy targeting young people and women ENI CBC Med
cours d'économie circulaire	FR	Paris	2,110,000	introductory	diploma	online		closed	Entreprendre dans l'économie circulaire—Cours—FUN MOOC (fun-mooc.fr)
circular economy course France	FR	Paris	15,400,000	university	relevant studies access	on campus	8830 EUR	open	MSc Circular Economy and Sustainable Innovation—ESDES

Table A2. Cont.

Typed Words	Country (IT = ITALY; SP = SPAIN; GR = GREECE; FR = FRANCE; HU = HUNGARY; FI = FINLAND; NO = NORWAY; DE = DENMARK; GE = GERMANY)	Vpn Location	Total Results	Course Type	Course Target	Modality	Price	Status	URL (The “URL” Column Collects the Top Result from the Given Research.)
Kreislaufwirtschaftskurs	GE	Berlin	452,000	vocational	diploma	blended	2490 EUR	outdated	Circular Economy and Sustainability Management Course—ALEA
circular economy course Germany	GE	Berlin	15,100,000	university	relevant studies access	on campus		closed	Master of Science in Circular Economy—NTNU
körforgásos gazdaság tanfolyama	HU	Budapest	3350	article				other	Circular Economy Knowledge Base—University of Pannonia—GTK (uni-pannon.hu)
circular economy course Hungary	HU	Budapest	1,410,000	miscellaneous	diploma	blended		open	Circular Economy Courses Ellen Macarthur Foundation
kursus i cirkulær økonomi	DE	Copenhagen	93,900	introductory	relevant studies access	on campus		open	CSR and circular economy—Further education in environmental technology Cphbusiness
circular economy course Denmark	DE	Copenhagen	2,220,000	vocational	professionals	on campus		open	Green and Circular Economy—dfcentre
kiertotalouden kurssi	FI	Helsinki	74,200	miscellaneous	diploma	blended		other	Trainings (turkuamk.fi)
circular economy course	FI	Helsinki	1,690,000	university	relevant studies access	on campus		open	University of Eastern Finland (ellenmacarthurfoundation.org)
kurs i sirkulær økonomi	NO	Oslo	171,000	introductory	professionals	online	6.450 NOK	open	Circular economy and competitiveness Bi
circular economy course Norway	NO	Oslo	2,840,000	university	relevant studies access	on campus		open	Circular Economy/Programme/Masters and Bachelor course search/StudyinNorway/Home—Study in Norway

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