Action plan: concept of circular economy applied in automotive industry
DRIVEN ERASMUS+ project

by
University of Pécs

Co-authors: Brigitta Balogh, Ildikó Horváth, Gabriella Medvegy, Anita Dolgosné Kovács, Csaba Vér

I. Situation and Key Players of the Circular Economy in Hungary

I.1. Strategic vision targeting circularity

The transition to a circular economy has become a pressing priority for many countries around the world, including Hungary. As a small open economy with limited domestic resources, Hungary recognizes the potential benefits of a more sustainable and efficient use of materials in driving competitiveness and economic growth. To guide this transition, an integrated vision with clear goals, quantified targets, and concrete actions is required. The Hungarian government set out a plan to make the country more competitive and sustainable by adopting a holistic approach to the circular economy transition.

An integrated vision, supported by clear goals, quantified targets, and concrete actions, is required to guide the circular economy transition at the national level. The strategic vision and goals of the National Circular Economy Strategy (NCES) have been developed by the OECD, in consultation with the project steering committee and the stakeholder working group, and have been validated by the Ministry for Technology and Industry (MTI). All stakeholders will collaborate to reach the targets set for 2040.

I.2. Strategic goals

To restrain the amount of materials consumed, the government will invest in research and implement incentives to foster resource efficiency through innovation, eco-design, product sharing, and reuse. Hungary aims to double resource productivity (GDP/DMC) to achieve EUR 2 per kg of material. This is an ambitious target that will require significant investment

in innovation and eco-design. However, it will also bring many benefits, including a reduction in waste and emissions, cost savings, and increased competitiveness.

Priority area is closing the loop of materials and making the use of materials more sustainable. Measures will be taken to double the Hungarian circular material use rate to 15%. This target is critical to ensuring that resources are used in a sustainable way and that the country can reduce its reliance on imports. Achieving this target will require a significant shift in production and consumption patterns, as well as investments in recycling and waste management infrastructure.

In order to capture a broader array of benefits related to transitioning to a circular economy, support mechanisms for innovation and new business models will be implemented. Hungary aims to increase the number of circular jobs by 30% across industry, agriculture, and service sectors to achieve 2.5% of total employment. This target is critical to ensuring that the benefits of the circular economy transition are spread evenly across society. It will also create opportunities for new business models, such as leasing and product-as-a-service models, which can contribute to reducing waste and resource use.

I.3. Supporting measures

The government also generally applies these principles in its decision-making areas, whether in the formulation of development goals or in the National Clean Development Strategy. The long-term objective is to ensure that the need to implement the circular economy is also reflected in more specialised areas, as exemplified by the National Strategy for the Battery Industry. Realizing this vision requires the support of all levels of government to facilitate the adoption of circular business models by the private sector and incentivize citizens to take ownership of the transition through a shift in behaviour. The circular economy transition will require significant changes in production and consumption patterns, and this can only be achieved through a concerted effort by all stakeholders. Education and digital technologies will be critical to fostering green jobs and resource-efficient value chains.

Here we would like to highlight the importance of higher education. It is higher education that trains the economic leaders of the future. The principles of the circular economy are therefore embedded not only in their education but also in their practical training. This process is also accompanied by the development of new courses, such as the management of the circular economy. In addition to the higher education institution, the practical training also involves economic operators in course of the compulsory internships, apprentice programs and dual training as part of the training process. The NCES has also drawn on academic research in its design and relevant research is ongoing. In addition, joint research between higher education and industry can lead to innovations with a significant impact on the circular economy. Collaboration can take place at different levels, from project labs to the development of hydrogen fuel cell vehicles, taking into account the academic capacity and the needs of industry. Technology and knowledge transfer are essential for competitiveness and support is therefore needed in areas of high economic importance, facilitating collaboration between higher education and industry. This has implications for both the quality development of professional training and related areas of research and development.

I.4. Relevance of the automotive sector

The automotive sector, which accounts for around 28% of industrial production, and the above-mentioned working battery programme justify the focus on the implementation of the circular economy in the automotive sector. Since the share of employment in the automotive sector is close to 4%, the need for adequate training of the workforce and the crucial presence of research, development and innovation aspects will focus attention on the promotion of university-industry cooperation. In terms of training, these can be implemented through internships, apprenticeships and dual training. Here I would like to highlight the importance of dual training, as it has a long history in Hungarian practice, and dual training as a form of education was brought to life by the needs of the automotive industry, among others. Highly skilled employees are extremely important in terms of development, and the up-to-date knowledge required is provided through close cooperation between the university and the place of practice.

Hungary is a small open economy with few domestic material sources available. Therefore, fostering circularity throughout its production and consumption patterns is critical to securing and improving its competitiveness. The circular economy transition will also contribute to reducing Hungary's carbon footprint and help achieve the country's climate goals.

In conclusion, the National Circular Economy Strategy (NCES) sets out an ambitious plan for Hungary to become a more competitive and sustainable economy by adopting a holistic approach to the circular economy transition. The targets set for 2040 are ambitious, but achievable with the right investments in innovation, recycling, and waste management infrastructure, as well as changes in production and consumption patterns. The circular economy transition will create new business models and green jobs, contributing to reducing waste and resource use, and help Hungary achieve its climate goals. However, realizing this vision will require the support of all stakeholders, including the government, industry, higher education, private sector, and citizens, and a concerted effort to shift towards circular business models and behaviours.

II. Interconnections between Hungarian dual training programs in higher education and circular economy

II.1. Introduction

A.) The goal of dual training programs in higher education

The goal of dual training programs is to prepare students for the workforce by providing them with a comprehensive education that combines theory and practice. This can help students develop a strong understanding of the industry, acquire relevant skills, and increase their employability upon graduation. Dual training programs are often considered a valuable approach to higher education as they can provide students with a well-rounded education that integrates academic learning with real-world experience.

II.2. The Dual Training Program in Hungary

The Government of Hungary introduced dual higher education in 2015, facilitated by the Dual Training Council, which is composed of prominent leaders from companies, chambers of industry, and universities.

A.) Definition of dual training in accordance with Nftv. § 108. 1.a. paragraph

Dual training is defined in accordance with the Nftv. § 108. 1.a. paragraph (*National Act on Higher Education*), which specifies that it is a form of training in technical, information technology, agricultural, natural or economic sciences, at the bachelor's or master's degree level, with a practical-demanding curriculum that is determined based on professional training and output requirements. The training takes place full-time, following a curriculum that includes unique provisions for the period, training methods, lessons, and evaluation of acquired knowledge, and it is conducted within the framework defined by the Dual Training Council at a qualified organizations.

B.) Full-time training with a practical-demanding curriculum at qualified organizations

Dual training enhances students' professional competence, company knowledge, and culture through its curriculum content, structure, and increased number of hours spent at companies, as well as the work experience gained. It is closely aligned with the curriculum of the higher education institution in a pre-determined manner and formally educates the students during the training. This system produces more workers from higher education who are job-ready without the need for additional annual training or financial expenditure, making it an effective solution for addressing the shortage of skilled workers.

Throughout the training period, students are entitled to remuneration for the work performed during the dual training, which is paid by the host company and is at least fifteen percent of the mandatory minimum wage (minimum wage) per week.

Trainers and mentors involved in organizing company internships have adequate theoretical and practical experience and support students in the development of their professional and working culture, as well as environmental awareness.

The dual education system is open, allowing both students and companies to withdraw from it at any time, in compliance with relevant legal provisions for termination of the employment contract.

C.) Integration of higher education theory and practical training

The curriculum is designed to ensure that the theoretical knowledge gained in higher education is applied and reinforced through practical training at the corporate partner. The content of the company practice is built on the theoretical material acquired during the entire training period, creating a seamless integration between theory and practice.
Alignment with degree requirements, sample curriculum, and corporate practical training plan: The dual curriculum is developed based on the government-approved degree requirements for the different Engineering BSc major, the sample curriculum provided by the contracted higher education institution, and the corporate practical training plan jointly compiled by the higher education institution and the corporate partner. These three documents are aligned to ensure consistency and coherence in the curriculum.

D.) Methodological concept for dual training

The methodology for the dual Engineer training is developed, which forms the basis for the cooperation between the higher education institution and the corporate partner. This methodology defines the training expectations necessary for the qualification of the receiving student participating in the dual training, taking into account the similarities and differences between the theoretical training in the traditional and dual systems.

E.) Practical training in five main areas

The period spent at the company is thematically divided into five main areas, including the development of "soft skills", occupational safety and work culture at the company, getting to know and performing special practical tasks, involvement in specific "operational" practice, developing the ability to work independently on project-type tasks, and development and consultation of a thesis topic. This provides a comprehensive and well-rounded practical training experience for the students.

F.) Collaboration with corporate partner

The dual Engineer BSc training involves close collaboration between the higher education institution and the corporate partner. The practical training materials are developed in cooperation with the corporate partner to align with the training output requirements, ensuring that the students gain practical skills and knowledge that are relevant and applicable to the industry.

II.3. Dual Training Programs at the University of Pécs

The Faculty of Engineering and Information Technology at the University of Pécs was one of the first institutions to adopt dual education format into its training portfolio, offering dual programs in mechanical engineering, electrical engineering, environmental engineering, engineering informatics, and civil engineering in BSc level since 2015.
The management principles of dual education at the University of Pécs include ongoing quality control through quality audits of the participating organizations, involvement of instructors with strong theoretical and practical experience, two-stage studies consisting of an institutional phase and a company phase, during which students are active participants in practical training at companies and acquire specific professional practical knowledge and work experience.

It's important to note that dual training models can vary depending on the regions, the different economic backgrounds, and connecting to these, there are different approaches or methodologies in different contexts.

II.4. The Dual Training Models in Hungary

A.) The Neumann János University of Kecskemét and its Dual Training Model

The Dual Training Model at the Neumann János University of Kecskemét is primarily developed in accordance with the needs of large companies, which are the prominent dual partners of the university. In this model, dual students undergo block system higher education institution education and company practical training. After 12 weeks of higher education training, students participate in a 5-week company internship, followed by a 3-week exam period. This is supplemented by an additional 8 weeks of company internship during the summer period. Students then have 4 weeks of vacation in August before starting their studies with renewed vigor in the next school year.

B.) The Széchenyi István University Győr Model of Dual Training

The Dual Training Model at the Széchenyi István University in Győr follows a different schedule that caters to the needs of a large corporate partner. In the first five semesters, students receive theoretical training at the university, while the emphasis in the last two semesters is on practice and project work. During the last two semesters of the seven-semester course, with corresponding breaks, students participate in flexible working hours at the industrial partner, gaining practical experience.

C.) The University of Pécs Model of Dual Education

In the case of economic environments where a large number of small and medium-sized enterprises (SMEs) represent the partner base of the higher education institution, the Dual Training Model at the University of Pécs follows a differentiated schedule based on the needs of the enterprises. This model requires significant preparation and continuous cooperation during the training from the participants, as it caters to the expectations of many SMEs that operate with a smaller number of employees and resources. The schedule used by the UoP Faculty of Engineering and Information Technology and its partner companies means that students must spend 26 weeks at the higher education institution and 22 weeks at the corporate partner, out of the 48-week training period per academic year.

- In the Standard Pécs Model, students spend 3 days at the university and 2 days at the companies in each educational week, and then take part in a longer continuous 5- or 6-week internship in the summer. Civil, electrical, and environmental engineers follow this model.
- IT-engineers developed Option1, where students spend 4 days at the university and 1 day at the companies in each educational week.
- Mechanical engineers follow the Option2, where the first 1/3 of dual program is similar to Option1 (4+1 days) while in the remaining semesters the Standard Pécs Model applies.

In each case, the legislative requirement is met i.e., the duration of practical dual activities reaches 75% of the theoretical program's timeframe.

Since the academic year 2020/2021, the Faculty of Engineering and Information Technology of the University of Pécs has organized admission to dual training in January of each

academic year. The programme starts in the 2nd semester of the academic year. This structure aims to give the student enough time to get integrated into university life and to enable first-year students to familiarise themselves with the dual training during the first semester.

In parallel with this measure, a course titled "Dual Academy" was introduced in the first semester of majors where dual training is available. Within this subject, we organize lectures where our partner companies can present themselves to our students, and we also arrange visits to our partner companies to show students the advantages of dual workplaces and to ensure that they can make an informed choice of company for their placement.
By introducing this subject, our purpose was to make our practice-oriented dual training known and accessible to as many full-time students as possible. The course allows students to get acquainted with our industrial partner companies as training locations, while companies can gain experience with the skills of the students who apply to join their training facilities based on the actual semester performance of the student. Following the introduction of the subject, the number of students enrolling in our dual training programme has increased significantly, doubling in 2023. **The national Dual Training Council recommends "Dual Academy" course** – first introduced by University of Pécs – **as an example of good practice among Hungarian universities that offer dual training**.

Advantages of the Pécs Model:

- Constant presence in the life of the company, providing students with a real-world understanding of the industry.
- Fixed 3-week exam period, which is well separated from company practice, allowing students to focus on their studies.
- 5 weeks of summer vacation, giving students time to rest and rejuvenate.

Disadvantages of the Pécs Model:

- Provision of continuous travel and accommodation for companies located further away, which can pose logistical challenges.
- Fast pace of work during the busy period, as students need to balance their studies and practical training in a demanding environment.

Overall, the Dual Training Models in Hungary, including the Kecskemét, Győr, and Pécs Models, offer different approaches tailored to the needs of large companies, corporate partners, and SMEs, respectively. Each model has its advantages and disadvantages, and careful consideration of the specific requirements of the companies and students involved is necessary to ensure successful implementation.

II.5. Advantages of dual training for partners

Here are the advantages of dual education from the point of view of the university, the company, and the student:

A.) Advantages for the University:

- Enhanced Reputation: Universities offering dual education programs are perceived as being more innovative and responsive to the needs of the job market, which can lead to an enhanced reputation and increased enrollments.
- Industry Collaboration: Dual education programs require collaboration between universities and companies, which can lead to partnerships and collaborations, providing opportunities for research and development, and funding opportunities.
- Improved Curriculum: Universities can align their curriculum with industry needs in dual education programs, ensuring that students receive relevant and up-to-date education, enhancing their employability.
- Increased Graduate Employability: Dual education programs can lead to higher graduate employability as students gain practical experience and develop job-specific skills during their studies, making them more attractive to employers.

B.) Advantages for the Company:

- Access to Talent: Dual education programs allow companies to access a pool of talented and skilled students who are being trained with the specific skills needed by the industry, making it easier to recruit highly skilled employees.
- Cost-effective Recruitment: Companies can use dual education programs as a cost-effective way to recruit and train potential employees. Students who have completed dual education programs are already familiar with the company's operations, culture, and expectations, reducing the need for extensive training.
- Innovation and Fresh Perspectives: Dual education programs bring in fresh perspectives and ideas from students, who can contribute to the company's innovation and growth through their academic knowledge and practical experience.
- Increased Retention: Companies that participate in dual education programs often experience higher employee retention rates as students who have completed their studies and gained practical experience during their education are more likely to stay with the company.

C.) Advantages for the Student:

- Practical Skills Development: Dual education programs provide students with practical work experience, allowing them to develop real-world skills that are highly valued by employers, making them more job-ready.
- Faster Career Entry: Students who complete dual education programs can enter the job market faster than traditional graduates as they already have relevant work experience, giving them a competitive edge.
- Enhanced Employability: Dual education programs can significantly enhance a student's employability as they gain both theoretical knowledge and practical experience, making them more attractive to potential employers.

- Networking Opportunities: Dual education programs provide students with opportunities to network with industry professionals, build contacts, and establish relationships that can help them in their future careers.

In conclusion, dual education programs offer a win-win situation for universities, companies, and students. Universities benefit from increased reputation, industry collaboration, and improved curricula. Companies gain access to talented students, cost-effective recruitment, and fresh perspectives. Students develop practical skills, enjoy faster career entry, enhance their employability, and build valuable networks.

II.6. Suggestions to support the goals of the circular economy through the dual training program

A.) Closing the skills gap:

Teach waste management, recycling including use of secondary raw materials (characteristics, mixing with primary raw materials, possible issues), and sustainable production in separate curricula/subjects related to each dual training field.
By incorporating these topics into the training, students can gain practical, hands-on experience and knowledge that prepares them for the workforce in sustainable industries.

B.) Promoting sustainable practices:

Include subjects or coursework on sustainable practices, such as reducing waste, reusing materials, and designing for the circular economy.
Introduce the possibilities of Industry 4.0 to the students.
Additionally, it is important to introduce students to possibilities such as online collaboration, including 3D VR spaces, remote control, and smart solutions, which can enable circular economy practices. This knowledge can contribute to environmental protection and circular economy practices by reducing travel, conserving resources, promoting circular economy principles, enhancing communication and collaboration, and facilitating education and awareness-raising efforts. By leveraging the power of virtual collaboration, these technologies can help promote more sustainable practices and contribute to a greener, more circular economy.
Students who receive this training are better equipped to work in industries that prioritize sustainability and can help promote the adoption of circular practices in their workplaces..

C.) Increasing innovation:

Encourage collaboration between academia and industry, leading to the development of new technologies and processes that support the circular economy.
Introduce a Disruptive technologies subject, where students can learn about the latest developments, analyse their benefits and risks, and their short-, medium- and long-term effects on the field, the wider society, environmental protection, and the circular economy.
Students who participate in these programs are exposed to the latest innovations in their field, which can inspire them to develop new ideas and approaches to sustainability.

D.)Encouraging entrepreneurship:

Include an entrepreneurial component that encourages students to develop their own projects and businesses that support the circular economy, such as companies that specialize in recycling or sustainable product design. A subject with the goal of creating new businesses that support the circular economy can motivate students to think creatively and contribute to the circular economy.
Overall, by implementing these suggestions, dual training programs can better prepare students with the skills, knowledge, and mindset needed to work in sustainable industries and drive innovation in the field of the circular economy.

III. Summary

The dual structure of higher education can integrate environmental protection, circular economy principles, and sustainability literacy into its curriculum, experiential learning opportunities, industry engagement, innovation, and entrepreneurship initiatives. This can help prepare students to become knowledgeable and skilled professionals who can contribute to addressing the environmental challenges and opportunities associated with the circular economy.