

CLIMACT



« The sectoral impacts of the climate transition: focus on activity, employment and training »

Methodology, main learnings and considerations

December 2024

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Introduction

The initiative on Belgium's transition to a climate-neutral society by 2050, developed by the Federal Public Service Health, Food chain safety and Environment (FPS Health)¹ highlights the profound changes and disruptions required to achieve a climate-neutral Belgian society by mid-century. It demonstrates that economic activities are likely to be significantly affected across a wide range of sectors.

In 2023, the FPS Health commissioned a report on 'Implications of the climate transition on employment, skills and training in Belgium'². The study gathers existing research and analyses on the implications of climate neutrality pathways for the Belgian labour market and provides a comprehensive overview of the challenges, including case studies on the building sector, circular economy and digitalisation.

Different reports and studies have been published in recent years on jobs and skills in the context of the climate transition. For example, a recent report of the High Council of Employment (2025) points out the need to combine climate and employment policies, increase STEM skills, support reskilling and upskilling, especially for employees in high emission sectors. However, to our knowledge, detailed analyses of these issues per subsector, do not exist to date.

Therefore, this study, with a subsectoral focus, was launched by FPS Health and conducted by Climact and IDEA Consult. Building on the previous report, this project has two main goals. First, it aims to develop highly specific recommendations on the policies needed to anticipate socioeconomic impacts from climate policies and transition scenarios. In order to analyse these challenges in depth, this study focuses on a limited number of 'subsectors'. The socioeconomic impacts concentrate on the number of jobs, the quality of employment, the skills needed and the relevant training and education implications.

Second, the study aims to inform the stakeholders in the subsectors on the socio-economic challenges of the climate transition. Therefore, the exchanges through workshops with subsectoral stakeholders are one of the core elements of this study. The study has also benefited from the guidance of a broad follow-up committee³. We would like to thank all participants for their cooperation.

To ensure the analyses and recommendations are as actionable as possible, a targeted selection and characterization of the subsectors to be studied is required. This task has two primary objectives. **First, the selected subsectors must represent a significant economic weight. Second, they must rank among the most critical for the transition, either due to their contribution to its success or the impact the transition may have on their level of activity and employment.** The identified subsectors are clustered in six groups to facilitate the creation of transition narratives: transport, agriculture and food industry, health, circular economy, R&D, education. Together, they account for 33,5% of total jobs in Belgium, and for 32,5% of the GDP.

The authors are aware that other megatrends could potentially have (large) impacts on the evolution in labour demand and skills. Some examples are digitalisation, robotisation, artificial intelligence and an ageing population. However, these megatrends are not included in the quantitative and qualitative analyses.

¹ <https://climat.be/2050-fr>

² <https://klimaat.be/doc/just-transition-jobs-2023-final-report.pdf>

³ The authors would like to thank the members of the follow-up committee for their contributions. The usual disclaimers apply. The follow-up committee was composed of civil servants from the federal and regional administrations, of which the employment administrations, FPS Finance and FPS Economy, the unions, employer representatives, the regional public employment and training services, the Belgian National Bank, the Federal Planning Bureau, environmental NGOs and academics.

This report delivers the study's results through a consolidation of main learnings and policy considerations. It goes together with a "factsheet" for each subsector group that was used to conduct workshops and bilateral interviews and contains more details, and a policy brief by the FPS Health.

1. Methodology

This report examines potential evolutions in employment and skill needs under scenarios of transition towards a climate-neutral Belgium for a number of subsectors. The study focusses on sectors that have a significant economic value in terms of employment and size of the sector, but are also underreported in light of the impacts of climate transition on labour. Therefore subsectors that are expected to experience a significant impact of the transition and that have a low level of maturity in terms of impact of the transition, are selected. More information on the selection of the subsectors can be found in Annex 1.

The methodological framework to estimate the impact on employment and skills balances quantitative and qualitative analysis, and leverages stakeholders' knowledge. All subsectors' groups were analysed with the following sequence.

- i. Identification of transition levers that directly impact employment
- ii. Estimation of labour market demand in terms of jobs, through a quantitative analysis, starting from the transition levers
- iii. Estimation of labour market demand in terms of skills, through a qualitative analysis, mobilising literature review, internal studies and consultations of experts
- iv. Identification of training needs
- v. Challenge of results and identification of policy considerations through workshops with stakeholders (1 for each group of subsectors), mobilising experts and sectoral stakeholders (business federations and syndicates)
- vi. Consolidation of learnings and completion of policy considerations

1.1. Identification of transition levers that directly impact employment

The starting point of the study are the three transition scenarios to a climate-neutral Belgium developed by the FPS Health⁴ and the levers that they mobilise. These transition scenarios give a robust framework to estimate the macro-trends in terms of labour market demand for jobs and skills generated by the transition.

Nevertheless, in some cases, levers could not be used to estimate labour needs, mainly because they could not be directly linked to jobs. In that case, either we proposed a new scenario (Agriculture & Food) or we developed a qualitative analysis that assumes all transformations generated by the transition scenarios.

1.2. Quantitative and qualitative analysis of labour market demand

The quantitative analysis aims to identify broad trends and underpin the associated potential gaps, rather than delivering precise figures for employment and skill needs. All figures outlined in this report should be taken as orders of magnitude. Consequently, and due to time constraints, we did not employ advanced modelling tools that other prospective studies on employment use.

Quantitative simulations could be done for *Transport* and *Agriculture*. For *Health* the partial quantification focuses rather on proposing a decarbonation scenario to derive skills demand. A qualitative analysis was done for *Circular economy*, *R&D* and *Education*.

To supplement the quantitative findings, qualitative tools were employed to integrate stakeholder perspectives and refine the analysis. The qualitative methods included:

- **Expert interviews:** In-depth discussions with domain experts to contextualize findings.

⁴ FPS Health (2021), Scenarios for a climate neutral Belgium by 2050, <https://klimaat.be/2050-nl/analyse-van-scenarios>

- **Literature review:** Comprehensive analysis of existing studies and competency profiles (for *Transport, Health and Agriculture/Food*) to identify trends and gaps.
- **Workshops:** Stakeholder workshops were organized for each subsector group analysed, providing a forum for direct engagement and feedback. The list of workshop participants can be found in Annex 3.

1.3. Limitations of the analysis

The analysis faces the following limitations that may influence the interpretation of results:

- **Data accessibility:** Challenges in obtaining comprehensive and reliable data limited the scope of the quantitative simulations.
- **Simplified parameters:** To simulate trends, the number of parameters was reduced, potentially obscuring finer variations. These variations might compound or neutralize each other in more complex models.
- **Stakeholder availability:** Some workshops were not conducted as planned due to participant cancellations, reducing the breadth of stakeholder input.
- **Interplay with other megatrends:** As outlined in a previous study on the transition's impact on employment, the transition towards climate neutrality is a megatrend that interplays with other megatrends such as digitalisation and demographic changes. This study focuses on the impact directly generated by the climate transition. This impact could be partially offset, or reinforced, by other megatrends.

2. Transversal learnings

The study underlines (1) that the climate transition will require many additional jobs for most of the studied subsectors; (2) that much more skills, and specifically technical manual skills, will be required and (3) that additional jobs are not opportunities that are automatically opened for declining professions.

There is a strong disconnection between prospective work on the climate transition and the design of (public) training programs, which focus on immediate and short-term issues. Without evolution, skills gaps (if not already striking) will be strong and will put at risk Belgium's climate transition and its socio-economic prosperity.

- **Belgium's public employment and training services** (FOREM, VDAB, Actiris, ADG and Bruxelles Formation) **focus on adapting to the demands** of businesses, which mainly consist in meeting the immediate needs of the labour market. This "reactive" model is coherent to fill shortages and ensures workers are employable and aligned with companies' current expectations but fail to identify and anticipate the significant needs in skills that the climate transition requires.
- **Similarly, sector funds** do not necessarily have a positioning that allows them to perceive emerging needs, which by definition do not have quantitative significance.
- **The process of defining skill profiles favours larger, established companies that have more resources to participate in forecasting and adapting occupational competency profiles.** This focus leads to the underrepresentation of small businesses and emerging sectors, who struggle to voice their needs. However, they account for a major part of economic activity in most of subsectors studied.

Many occupational profiles or *beroepscompetentieprofielen* for key professions do not completely embed skills required for the transition. It is specifically preoccupying as updating the frameworks is a slow and complex process involving many stakeholders, delaying their alignment with educational content. Moreover, **skills acquired outside formal education are not consistently recognized or certified.** This limits the ability to formalize the competencies required for the transition.

Collective bargaining coverage rates are lower for emerging and growing jobs, which might result in poorer working conditions, thus low attractivity, and a very weak integration of skills' needs into training programs. Without significant and quick efforts to structure emerging activities, the transition is at risk in a series of subsectors. Trade unions could potentially play a larger role; however, they currently represent only a small fraction of jobs in these businesses, primarily due to legal thresholds. Therefore, sectoral funds and other intermediate institutions (1) play a critical role in developing the support framework for small actors and (2) should for that purpose work in a closer collaboration with emerging and sustainable-oriented businesses networks, such as for example the Kaya Coalition in Wallonia.

In terms of training, significant challenges remain in developing relevant training content while reaching the right audience is crucial. Specifically, striking the right balance between general and specialized competencies, with relevant and actionable information, is key to shaping meaningful training programs.

Moreover, continuous training for decision-makers targeted on the integration of climate risks into business models is key and often overlooked, as such high-skilled profiles are less subject to employability issues. The integration of climate issues into initial training is a must but will give results only when the trainees reach a decision-level position, meaning at least 10 to 15 years. Specific training for decision makers is necessary to align their decisions and view on forthcoming labour and skills needs with the transition requirements, therefore fostering the evolution of training programs.

Robust strategies and reskilling plans are lacking, meaning that additional jobs do not represent a real opportunity for declining professions. As an example, converting automotive mechanics into bicycle repair roles or transferring nurses from hospital settings to mobile nursing services are just a few examples illustrating that the connection between declining and emerging professions is neither automatic nor linear.

For all sectors, change management skills and jobs are perceived as essential but missing. This supposes (1) upskilling for all managerial positions linked to jobs that will undergo significant transformation(s) and (2) training profiles specialized in accompanying institutional change, capable of mobilizing and involving a diversity of players, such as hospitals, companies or federations, in a collective dynamic of transformation. Those skills mobilise “know how skills” that must be developed throughout all the educational pathways.

Two factors will significantly influence training and employment strategies across different sectors: (1) the level of internationalization of production chains and (2) the level of complexity and specificity of the skills and techniques required for the sector's transition. These two dimensions interact to shape the appropriate strategy to adopt. The more internationalized a sector is, or the more complex the skills it requires, the less impact structured intervention through regional or community training mechanisms will have. In such cases, public authorities' capacity to act will rely on establishing minimum standards and norms, as well as on supporting and guiding companies directly in their training and oversight approaches. Specific challenges arise when the learning associated with the transition touches on trade secrets. In such scenarios, generalized interventions are ineffective and direct support for businesses is essential, with an explicit allocation of means to address transition-related challenges.

3. Transversal policy considerations

- **The efficiency and the agility of the training chain (from institutions to companies)** must be strengthened to better integrate new skills. Specifically, public administrations should:
 - **Map the networks of emerging “green businesses” and support their integration into the training ecosystem.**
 - **Fasten the recognition of new professions** via reduced bureaucratic hurdles and enhanced coordination among regional and federal bodies. A streamlined approach should ensure that training programs remain responsive to evolving labour market demands.
 - **Simplify and standardize legal frameworks for internships and apprenticeships across Belgium.** This harmonization would improve student integration, reduce administrative complexity for businesses, and ensure consistent regulations nationwide.
 - **Nominate a government-supported mediator, such as an extension of VDAB, Actiris, Forem, or Bruxelles Formation, or create a new entity in collaboration with professional federations or sectoral training funds to connect businesses and educational institutions.** This mediator would streamline internships, thesis projects, and apprenticeships by translating business needs into academic projects, reducing administrative burdens, and helping companies access funding for collaborative research.
 - **Provide a clear mandate to professional associations and economic actors** to accelerate the development of training programs for emerging skills. Offering incentives for early adoption and fostering innovation in workforce training will drive a faster and more inclusive adaptation process.
- **Public administration should support public training bodies in switching from a market-reactive posture to a proactive and forward-looking posture where they would be at the forefront of jobs and skills foresight**, with an independent and neutral view, built on transition scenarios. They should be either equipped or fed by inputs from specific foresight tools (observatories, future-oriented research, forward looking exercises...).
- **All initial education programs should integrate social and economic impacts that reflect the complexity of the climate transition into curricula.** Current (economic) education often focuses on models (limitless resources, disconnection between value creation and its climate/environmental impact) that are not compatible with the climate transition. This creates a mismatch that can lead on to “sustainable” jobs being perceived perspectives-less.
- **Policymakers, along with regional education authorities, should implement targeted programs and national awareness campaigns to attract more girls and students from diverse backgrounds to STEM careers.** These programs should highlight how STEM skills can address environmental challenges and contribute to a climate-neutral Belgium, making these fields more inclusive and appealing.
- **Initial training actors should integrate into courses mandatory and both discipline-specific and transversal climate transition courses.** This would foster interdisciplinary reflection and ensure alignment between green skills development and broader educational objectives on individual and collective climate impact.
- **Communication campaigns to make skills and job opportunities related to the low-carbon transition visible** should be implemented with no further delay.
- **Training facilities operators should walk the talk.** Training infrastructures (school, training centres) are often very far from symbolising a climate-neutral Belgium and must evolve rapidly to lower their impact (energy efficiency, food, mobility, etc.).

4. Transport

4.1. The transformation of the transport sectors to reach 2050 climate objectives

The transport sector will have to reach (almost) 100% GHG emission reductions to ensure climate neutrality in Belgium in 2050. It corresponds to a yearly emissions decrease of 17% (CAGR) for the coming 2 decades, while they have only decreased at a pace of 1%/year (CAGR) over the past 2 decades. Significant behaviour changes should happen to reduce energy demand. In addition, technological switches, in particular electrification, will allow decarbonising the remaining energy consumption.

By 2050, societal changes (like remote work and urban densification) result in a **decreased need to travel and thus a decreased total passenger transport demand compared to a reference scenario (between -5% and -29%)**. This demand would however be (slightly) higher than its 2015 level in the Core95 and TECH scenario, but slightly lower in the BEH scenario.

The total number of cars shrinks by 2050 due to a modal shift, a higher occupancy and an increased usage per vehicle. The modal share of cars falls from 75% (in 2015) to 61% or even 39%, depending on the scenario. This should benefit railway, public transportation (bus, tramway, metro) and active modes. Higher occupancy and utilisation rates and development of the sharing economy should also contribute to drive down the number of cars.

The total number of trucks and vans decreases significantly by 2050 due to modal shift, a higher load factor and increased utilisation rate. Freight demand should be slightly higher than the 2015 level but sees a significant decrease by 2050 compared to a reference scenario (between -24% and -29%). This should go together with a decrease of trucks' modal share, from 73% (in 2015) to 49%-66% across scenarios. This would lead to an increase in the use of inland waterways, railway, and active modes for the last mile deliveries. At last, both the load factor and the utilisation rate should increase.

Besides behavioural changes, technological evolutions contribute to the drastic reduction of energy demand. Most new cars are powered by electricity while freight relies significantly on hydrogen, e-fuels and potentially biomass.

This study focuses on the impact that these transformations will have on a series of NACE codes⁵ linked to the downstream part of the transportation value chain (use and maintenance). Activities linked to production, already well documented, and selling are not included in the scope.

4.2. Labour market demand in terms of jobs

The quantitative simulations⁶ that we performed on the top 20 professions (in terms of current volumes) suggest that 25% of these professions will see their volume being significantly impacted by the transition. **Additional workers will be required for three professions:** locomotive engine drivers, bus and tram drivers, transport conductors. **The number of workers will decline for two professions:** heavy truck and lorry drivers, motor vehicle mechanics and repairers. Additionally, simulations were performed on the emerging professions of bike couriers and bicycle mechanics. The impacts of megatrends, such as driverless vehicles, are not included in these simulations, as mentioned in the introduction.

⁵ 452, 461, 462, 463, 464, 466, 467, 469, 491, 492, 493, 494, 501, 502, 503, 504 521, 522, 531, 532

⁶ See the factsheet in annex for the detailed methodology

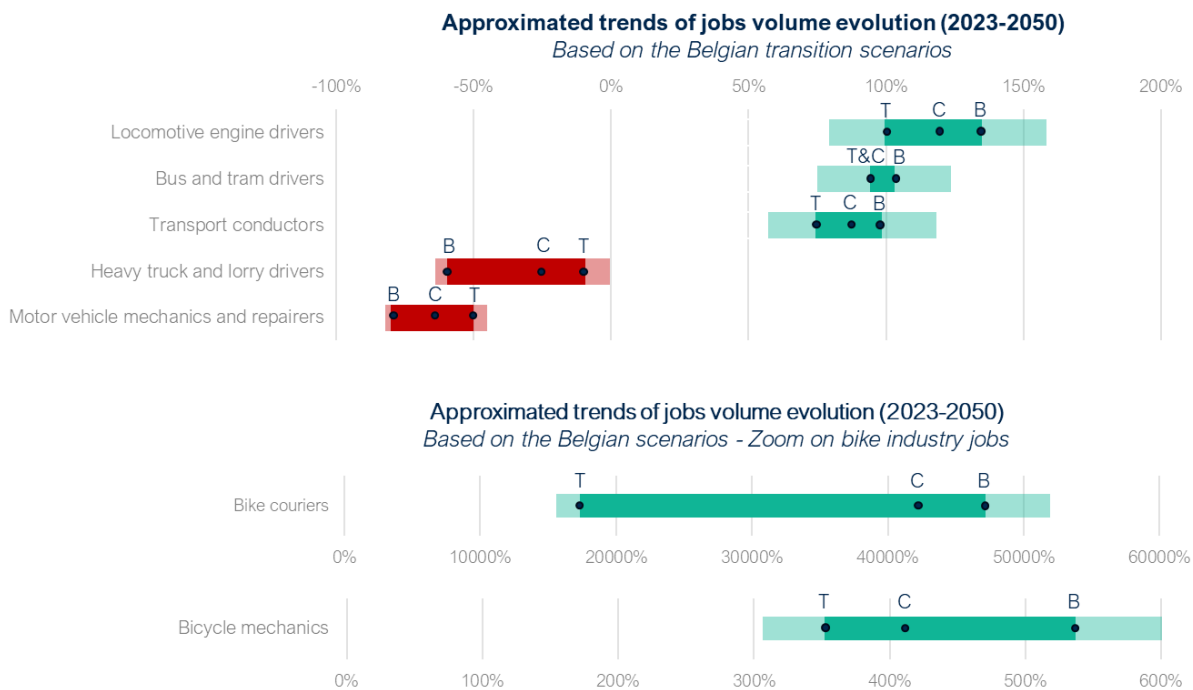
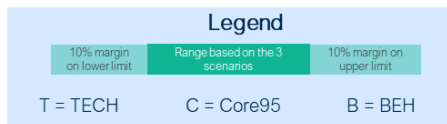


Figure 1 - Approximated trends of jobs evolution for the professions that should be the most affected by the transition.

As Figure 1 shows, our simulations suggest the following impacts of transition scenarios:

- **Last-mile deliveries require a tremendous amount of additional bicycle couriers.**
- **The need for bicycle mechanics is expected to skyrocket by 2050**, resulting from modal shifts both in passenger transportation and freight. Important to note that this starts from very low absolute numbers in 2023.
- **The demand for public transport drivers (bus, tram and train drivers) will double**, mainly for passenger transport (bus and tram drivers, ticket controllers). The growth for locomotive engine drivers is even more pronounced as it is touched by the modal shift in both passenger and freight transport.
- **The shift to electric vehicles severely reduces vehicle mechanics jobs**; by a factor between 2 and 5, across scenarios. Indeed, it implies a strong reduction of maintenance needs, which could represent a turnover reduction of ~-30% for repair shops, according to the literature, despite more costly and longer operations (up to 20% more time/operation).
- **The number of truck drivers may (sharply) decrease, because of the modal shift for freight and the optimisation levers** (e.g. increased load factor). However, truck driver is a profession that is (1) already in shortage and (2) characterised by a European (labour) market (many truck drivers driving on the Belgian roads are not employed in Belgium). These two considerations limit the impact on the sector's labour market in Belgium.

The job volume evolutions required for transition scenarios are not yet observed in current trends, as outlined in Figure 2 below. The trends are even opposite to needed evolution for locomotive engine drivers and bus and tram drivers on the one hand, and for motor vehicle mechanics and repairers on the other hand.

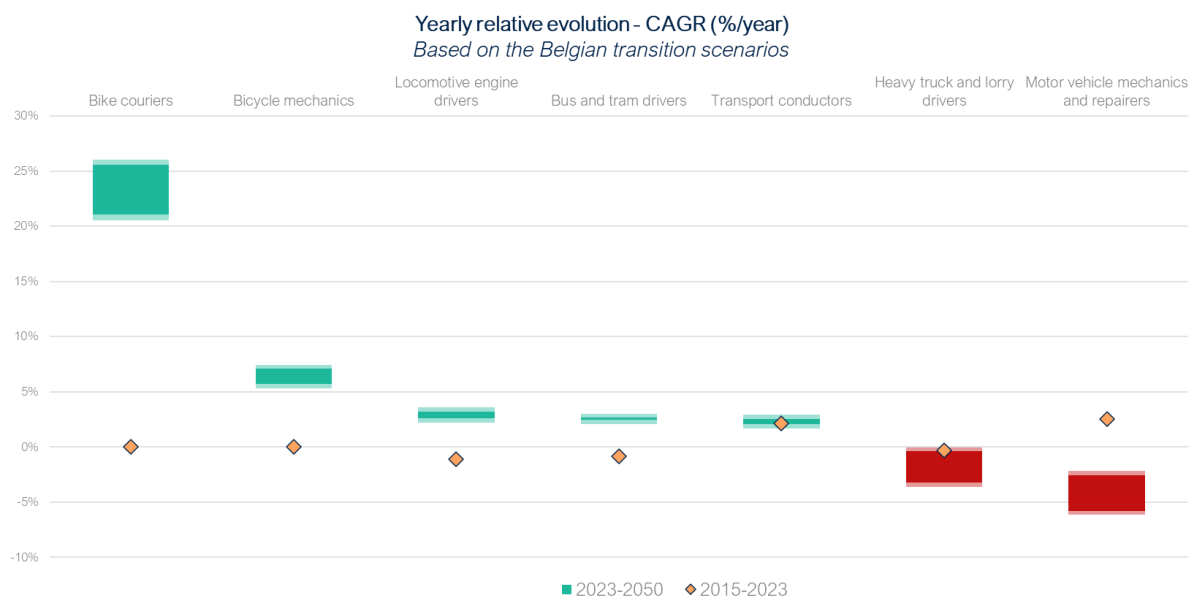


Figure 2 – Comparison between required evolution of jobs volume and current trends, for the most impacted jobs

4.3. Availability of workers in context of workforce shortage

The transport sector suffers from three types of shortages: (1) for jobs which volume should increase (in green on the figure 2) (2) for the job which volume will decrease (in red on Figure 2) and (3) for jobs in logistics, which are key for the transition but which volume won't significantly change (not shown on the figure)

For the jobs which volume will increase, the shortage of bus drivers, as well as train and metro operators, is a growing concern. One of the main barriers is the high cost of obtaining the necessary qualifications, such as the D licence and the professional competence certificate, which discourages many potential candidates. The profession is further strained by an ageing workforce, with two-thirds of drivers aged 50 or older. This demographic challenge is expected to worsen labour shortages in the coming years as retirements outpace recruitment. Additionally, difficult working conditions exacerbate the issue. For school bus drivers, part-time and seasonal contracts result in unstable incomes, making the role less attractive. For other roles, shift work and irregular hours act as deterrents for new entrants⁷.

For the jobs which volume will decrease, a detailed assessment of retirement rates is necessary to better understand the actual scale of the workforce gap and to determine the real need for occupational reconversions. Next to this, there are specificities by professions:

- **Vehicle mechanics** face severe talent shortages for both light vehicle and heavy truck mechanics, largely due to a lack of technical skills among candidates.
- **For truck drivers (who are in significant shortage)**, this issue is compounded by an ageing workforce, which is expected to worsen the current deficit.

For the jobs in logistics, both high-qualification and low-qualification jobs are in shortage, notably:

- **Logistic managers face a skill gap not specific to the climate transition**, especially in non-technical skills (leadership skills, language skills).
- **In Flanders, there is a specific shortage of forklift drivers ("heftruckchauffeurs") and reach truck drivers ("reachchauffeurs")**, primarily linked to challenging working conditions, including temporary contracts, shift work, low wages, and high employee turnover.

⁷ Forem – Veille, analyse et prospective du marché de l'emploi (2024)

4.4. Labour market demand in terms of skills

Bicycle mechanics will need advanced technical skills to adapt to rapidly evolving technologies (e.g. gear systems incompatible with speed pedelecs). Beyond technical expertise, they will play a critical role in educating consumers on maintaining electric bike batteries and adopting sustainable practices. The rapid pace of technological innovation in the sector underscores the need for continuous skill updates. Experienced candidates with these specialized competencies are particularly sought after, yet they remain in short supply.

Last-mile delivery drivers using light-duty vehicles, will require proficiency in using advanced route-planning software and algorithms that optimize delivery routes and minimize empty runs. They will also need to have general knowledge in new eco-driving standards (when using compact and electric vehicles, for example). While current competency profiles highlight the importance of avoiding empty mileage, they must be updated to include comprehensive skills for advanced planning.

Car mechanics will need advanced electronic and diagnostic skills, particularly for the maintenance of new engine types (from internal combustion engine (ICE) to electric engines (BEVs and FCEVs)). Mechanics will also need to adopt sustainable car repair practices (e.g. recovering and reusing materials, optimizing resource use), which, encouragingly, already appear to be well integrated into current occupational competence profiles.

Similarly, because of the development of logistic hubs, truck drivers will require upskilling, proficiency in using embedded technologies such as advanced fleet management systems, and knowledge of new environmental regulations. However, the foreseen significant decrease in number of truck drivers may not lead to high reconversion issues in Belgium, since this job is characterized by an old average age (many close to retirement) and many outsourced drivers from eastern European countries.

Procurement and logistics managers will play a pivotal role in advancing green logistics. Their responsibilities will include efficient reverse logistics to manage returns, unsold goods, and waste while reducing costs and environmental impact. Both roles will also require the integration of sustainable practices across sourcing, warehousing, delivery, and packaging. However, current occupational competency profiles lack explicit references to the environmental and technical knowledge necessary for this shift. Updating these profiles is critical to include expertise in green logistics strategies, multimodal transport management, reverse logistics, risk management, and enhanced communication and awareness skills to align with the sector's sustainability goals.

4.5. Training needs

Skills and jobs evolutions generate significant challenges for the training system that can be divided into three primary areas:

- (1) Reskilling needs due to career conversions
- (2) Upskilling the existing workforce
- (3) Enhancing initial training to ensure future workers are adequately trained

Reskilling needs due to career reconversion

The anticipated decline in demand for certain jobs, such as truck drivers and vehicle mechanics, raises the need for career transition opportunities within the sector. For instance, roles in rail freight, cycling logistics, inland waterways, or material handling could offer alternative employment paths. However, this transition requires a strategic approach:

- **Mapping roles that align with existing skills:** how do existing skills of truck drivers and vehicle mechanics align with the requirements of these alternative sectors? For truck drivers, some skills like route planning, vehicle maintenance and operational safety are transferable and some sector-specific skills

(e.g. rail system operations) will need to be added. For vehicle mechanics, mechanical skills can be adapted to new technologies and maintenance requirements for bikes.

- **Assessing and quantifying the training and reskilling needs**, to facilitate smooth career transitions into these roles.

Upskilling existing workforce through lifelong learning

Most roles in the sector require **enhanced technical and green skills**, rather than entirely new competencies, to keep pace with technological advancements and environmental goals. However, the sector faces barriers such as financial constraints and labour shortages, limiting time and resources for training. To address these challenges, the focus should be on:

- **Short, practical trainings:** Lifelong learning programs should focus on affordable, workplace-integrated sessions that workers can access without prolonged absences.
- **Vocational training centers:** Leveraging existing centers, such as those used by automotive companies for mechanics, can ensure continuous skill development aligned with industry advancements.

Sectoral federations representing the transport and logistics sector (Febetra, TLV, UPTR, BCLF, FEBIAC, Traxio, FBAA, etc.) are the best positioned to lead these training efforts. In collaboration with sectoral funds (Educam, social funds bus & car, etc.), they can design and implement programs tailored to both company-specific needs and broader sectoral goals. Some federations have already begun incorporating green skills into their training programs:

- TLV Flanders includes sustainable transport in its curriculum
- Educam offers courses on transitioning to electric and hydrogen vehicles
- Traxio integrated environmental themes into federal level programs
- VRA provides eco-driving lessons for taxi drivers
- VIL focuses on green supply chain practices

Enhancing initial training to ensure future workers are adequately trained

Moreover, to ensure the workforce is future-ready, it is essential to improve initial training for both existing and emerging professions.

- **For emerging roles (e.g. bike mechanics):** While sustainability-focused repair and maintenance skills are already part of competency profiles, there is a growing need for additional training in sales, repair, and maintenance to support the sector's rapid expansion. Here, initial training should be mainstreamed in more teaching institutions.
- **For existing roles (e.g. truck drivers, freight handlers, logistic and procurement management):** In general, initial training programs must ensure that all essential skills for the transition, in particular those not yet integrated into current occupational competency profiles, are updated, because they define the content delivered by education and training institutions. This will help future professionals acquire the necessary expertise to meet sectoral demands. Specifically to truck drivers, increasingly structured training programs need to be offered at the sectoral and/or EU level, to match with the international aspect of the market. For more details on these competencies, we refer to the transport factsheet.
- **Reskilling of car mechanics into bike mechanics is an opportunity to further investigate and plan.** Beyond the salary gap, which remains the main limiting factor for such reconversions, training and communication should emphasize a narrative that presents bikes as appealing objects to work on, building on the aspects that attract mechanics to car repair. Indeed, stakeholders underline that many car mechanics do their job also out of passion for cars.

4.6. Policy considerations

The federal minister for Employment, in cooperation with trade unions and employer organisations, should integrate all bicycle courier companies into the same joint committee, ensuring equal socio-economic conditions, stronger legal protections, and a platform for dialogue between employers and workers in cyclo-logistics. This should result in a unified framework that addresses the status and protection of bicycle couriers. This currently ranges from independent contractors to employees, which creates inconsistencies leaving many couriers insufficiently protected and vulnerable to exploitation.

The federal government should work on a quick implementation of the European directive on platform work, which aims at improving working conditions for individuals employed through digital platforms. This directive introduces two significant advancements: it provides clear guidelines for determining the professional status of platform workers, ensuring they are appropriately classified, and it sets the first EU-wide rules on the use of algorithmic systems in the workplace. These measures are a step forward in addressing the challenges posed by the development of cyclo-logistics⁸.

Training centres and sectoral funds, such as Educam, should give attention to the quantity and quality of training programs related to complex logistics and last-mile urban deliveries, as this function will play a lever role in the transition.

For heavy duty vehicle drivers and last-mile delivery drivers, **governments together with social partners should make structural efforts to improve working conditions** and ensure the quality of employment, and thus increase attractiveness. Communication oriented towards the positive climate impact could be helpful, but climate will be a co-benefit rather than the main argument to attract people.

⁸ *EU rules on platform work*. The Council of the EU and the European council, 2024

5. Healthcare

5.1. The transformation of the healthcare sector to reach 2050 climate objectives

Direct GHG emissions from the healthcare sector are mainly due to building use. These emissions should be cut thanks to energy renovation of buildings and are not the focus of this study as they are not expected to impact the jobs and skills of healthcare personnel. **Another source of direct emissions is the use of anaesthetic gases,** which however account for a very little share of the sector's emission.

Most of the healthcare's sector impact lies within its indirect emissions. Therefore, this study looks at the carbon footprint of the healthcare sector. From existing studies⁹, we derived that pharmaceuticals, medical devices, and equipment may contribute to over 40% of the sector's total footprint, while buildings (around 20%), transportation (10–15%), and food (10%) represent other large emission sources. These figures, however, remain imprecise and difficult to monitor. **The overarching assumption is that the sector plays a role in reaching net-zero, by a radical switch towards a preventive system.**

Indirect emissions from drugs and equipment purchase account for most of the sector's footprint and requires activating consumption reduction levers.

As the healthcare sector is mostly a “usage” sector, transformation will come on the one hand from **behavioural changes of practitioners** (development of circular practices, less prescription of drugs) **and patients** (with the support of practitioners), and on the other hand from **the decarbonisation of the pharmaceutical industry** (reduction of the drugs' emission factor, relocation of production).

The indirect emissions from medical equipment purchase decreases by 90%¹⁰ by 2050. This goal requires (1) emission factors for medical equipment to be at least halved, (2) an expansion of circular practices, and (3) reduced demand for new equipment, driven by preventive care. Interviewed stakeholders estimate that the sector does not (and will not) have a sufficient power over biomedical industry (for example, through their purchasing) to contribute to activating point (1). This study therefore focuses on the impacts of points (2) and (3).

Across all scenarios, the indirect emissions from the pharmaceutical products' purchase and use fall by 87% by 2050, activating a combination of 3 levers: reduction of the drugs' emission factor, decrease of wasted drugs, and less drugs used thanks to preventive care. Considering that the healthcare sector has very low impact on the drugs' emission factor but can contribute to lower the volume of drugs that are wasted and consumed, simulations were done by setting the drugs' emission factor as a fixed parameter, different for each scenario, and using the reduction of drugs waste and drugs consumption as variables to reach the 87% of reduction.

Results aim at analysing the required behavioural (thus skills) evolution for practitioners, depending on what can be achieved in terms of pharmaceutical products decarbonisation. The differences between scenarios for the drugs' emission factor reduction level allow to consider different hypothetical values (not precisely calculated in this study) for drugs import. Indeed, pharmaceutical manufacturing is highly concentrated outside Europe, controlled by a few corporations that operate beyond EU regulatory frameworks, making it difficult for Belgian stakeholders to influence production standards.

⁹ Total emissions from “Belgium health sector emission factsheet, Healthcare without Harm (2014)” with relatives shares derived by CLIMACT from “Décarboner la Santé pour soigner durablement, The Shift Project, 2023”.

¹⁰ Following the FOD CORE95 scenario for the *manufacturing* sector.

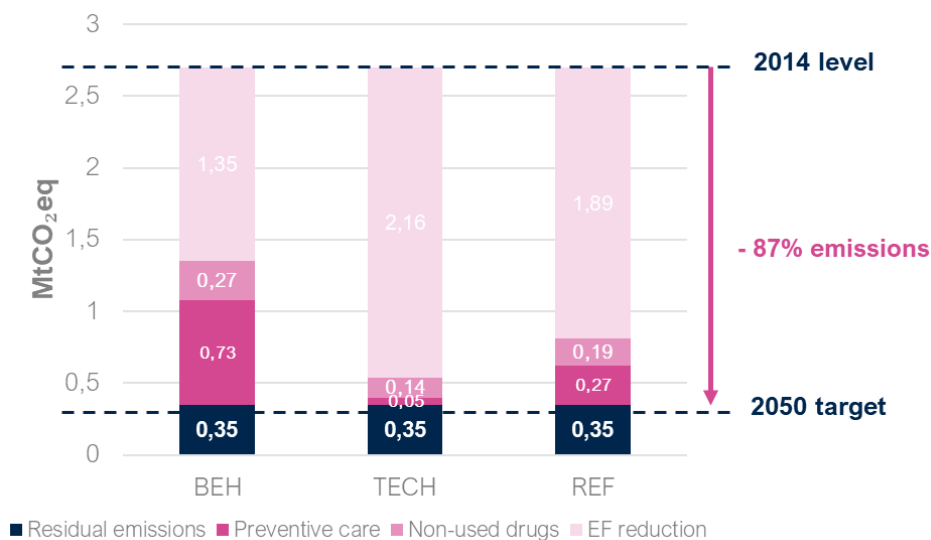


Figure 3 - Simulations of levers to reduce indirect emissions from pharmaceutical products.

A massive shift from a curative to a preventive healthcare system

By 2050, **primary and secondary prevention** is activated, across all transition scenarios. This allows for a drastic reduction in consumption and waste of healthcare practices and drugs¹¹, by promoting “Health” (centring practices around health rather than diseases) and the “Right Care” (avoiding overprescription).

Primary prevention offers the greatest potential for both cost savings and emissions reduction. By promoting “Health” the number of people who fall ill reduces, thus driving down the need for medications, medical devices, and hospital-based interventions. However, primary prevention seems to be influenced mainly by other actors than the healthcare system.

Secondary prevention consists in the adoption of "Right Care" principles, which aim to eliminate overprescription and encourage evidence-based, patient-centred care. This transition demands a profound reorganization of the healthcare system to recognize and prioritize the value of prevention, including its "non-cost" benefits, as much as traditional tangible costs.

A shift towards a preventive system has already been a priority objective for the sector for economic and sanitary reasons. In that sense, the climate transition offers an additional argument to shift towards a preventive system. On the other hand, other megatrends, such as the ageing population and the effects of climate change, might make the assumed drastic reduction in healthcare consumption even more challenging.

The next sections focus on the evolution in medical practices needed for the shift to a preventive system.

5.2. Labour market demand in terms of jobs

Belgium’s healthcare sector is diverse and growing. This study focuses on personal care services¹², which account for 5% of the Belgian GDP and employ over 507,400 workers (14.5% increase in workforce over the past decade). The qualitative analysis done in this study together with stakeholders’ feedback suggests that the different transition levers will mainly require **healthcare jobs to transform. Evolutions in labour demand should not be strong, and focus on (1) the implementation of circular practices and (2) change management** (within healthcare facilities, and to develop home care).

¹¹ (~50% of wasted drugs in France) or unjustified consultations (56% of emergency consultation are non-justified in Belgium (Berchet, 2015)).

¹² The activities covered under this study are classified under NACE codes 861–869 (human health activities) and 871–873 (residential care).

- The additional volume of workers required to develop circular practices is hard to estimate. Various roles will emerge. They should be those of technicians (for sterilisation), logisticians, regulatory compliance experts and quality insurance engineers.
- Additional operational jobs aimed at **embedding sustainability across all operations are required**. These roles are estimated to be additional jobs, dedicated to people with key expertise, rather than an additional responsibility of existing management. Key emerging positions include transition-focused change managers, who will oversee decarbonisation efforts and legal experts that specialize in sustainable public procurement.
- A higher demand for **decentralized healthcare workers is foreseen, to support the development of homecare**. This care model has been rising and may be a solution to activate preventive levers.

It is worth adding that adaptation to climate change (out of the scope of this study), **will add further complexity to workforce requirements**. Stakeholders underline that adaptation will likely lead to **a significant increase in demand for certain roles**, while workforce availability may decrease due to the pressure of climate-related crises. In Belgium, the precise impact of climate adaptation on the volume of healthcare jobs is not very well known, but stakeholders estimate that it will require **flexibility in workforce planning**. For example, the need for emergency department specialists may surge during extreme weather events, but these roles will not always be in constant demand. As such, training for these specialists must be designed to include complementary skills, allowing them to adapt and contribute to other areas of healthcare when their expertise is not immediately required.

Given the long duration of initial education of doctors, changes in the numbers of doctors per specialty need to be planned well in advance. Both the effects on the workforce of adaptation to climate change and the shift to a preventive health system need to be taken into account in this process.

5.3. Availability of workers in a context of workforce shortage

Medical practitioners, nursing (associate) professionals, and healthcare assistants are experiencing a structural shortage due to difficult working conditions (hours, travel, workload, salary) **and an ageing workforce**¹³. The shift towards a preventive system might create a decrease in the labour demand, especially for nurses, which could help to alleviate the workforce shortage. It would be insightful to assess these effects, considering nevertheless that ageing of the population and climate change effects could offset the gains.

- For doctors, managing access to the profession within the INAMI framework and meeting working hour standards exacerbate the situation.
- **For nurses, the sector already suffers from a labour shortage of 5% today, which might increase to 10-20% between 2030 and 2040**¹⁴. This is mainly due to educational reforms and the sector's image.
- **Healthcare assistants face similar issues**, compounded by the increasing demand for healthcare services due to an aging population and advancements in medical knowledge and treatments. Recruitment tensions are expected to worsen due to aging, with nearly two out of five workers being aged 50 or older¹⁵.
- There already seems to be an acute shortage of logistics professionals, which needs to be addressed because of their essential role in hospital operations.

5.4. Labour market demand in terms of skills

Shifting to a preventive system and implementing circular practices will require upskilling for general practitioners and healthcare facilities managers.

¹³ Forem – Veille, analyse et prospective du marché de l'emploi (2024),

¹⁴ Stakeholders estimation

¹⁵ Forem – Veille, analyse et prospective du marché de l'emploi (2024)

General practitioners will require upskilling to shift away from a prescription-focused model to becoming proactive guides for prevention-oriented behaviours. The **following additional skills are required:**

- **Understanding of the healthcare sector's impact on climate change** (including climate-energy issues and the carbon footprint of the sector)
- **Fundamental expertise in environmental health** (the links between climate change and human health), and a comprehensive grasp of the current curative Western healthcare system
- **Effective communication and awareness-raising skills**, especially for general practitioners and nursing professionals to educate and engage patients in adopting sustainable and health-conscious behaviours.

Healthcare (operational) managers will require upskilling to enable (1) the development of circularity and (2) to set and roll-out decarbonisation plans.

- **To develop circularity, skills in sustainable healthcare design to reduce environmental impact and enhance resource efficiency** are required. This includes expertise in the eco-design of care practices, eco-prescription, and resource management. These competencies will allow sustainable practices to be implemented at every level of patient care, fostering a more environmentally responsible and resource-efficient healthcare system.
- **Advanced techno economic skills are necessary to implement effective decarbonisation plans within hospitals.** Existing actions are led by a few pioneers. Healthcare managers should be upskilled so that they can transform the economic model of healthcare facilities and reach energy and GHG emissions reductions. Giving the existing role of pioneers, the upskilling of healthcare managers should aim at fostering the launch of innovative projects within facilities, to test and upscale the successful models.

5.5. Training needs

To equip the healthcare sector for the changes required to achieve decarbonisation, it is essential to integrate the necessary skills and knowledge into both initial and continuous training programs.

The analysis of competency profiles for various healthcare professionals¹⁶ reveals significant gaps regarding required skills for circular practices and the need for updated competency profiles.

- Skills related to climate and environmental health are largely absent, underscoring the urgent need to embed environmental health education into initial training.
- **Furthermore, these profiles lack references to essential competences such as eco-design of care, eco-prescription, or resource management.** While there is a clear emphasis on prevention and health promotion (e.g. understanding primary, secondary, tertiary, and quaternary prevention, and educating patients about healthy lifestyles), the integration of skills that could significantly reduce the environmental impact of routine practices remains limited. Embedding such competences into training programs is essential to empower healthcare professionals to adopt more sustainable practices.
- **Education authorities should prioritize the integration of specialized eco-design training tailored to healthcare settings within higher education curricula for engineers and industrial designers or through specific on-the-job trainings.** This training should include dedicated modules focused specifically on the unique requirements of hospital equipment and infrastructure. The curriculum must cover key areas such as designing energy-efficient solutions, conducting carbon footprint assessments of hospital operations, and developing sustainable medical devices and infrastructure. By equipping future professionals with these targeted skills, the healthcare sector can accelerate the adoption of innovative, low-carbon technologies and ensure that hospitals meet stringent sustainability goals while maintaining high standards of care.

¹⁶ Including generalist and specialist medical practitioners, nursing (associate) professionals, healthcare assistants, and directors of medico-social establishments)

- **For managerial roles, such as directors of medico-social establishments, the absence of key skills such as project management, strategic planning, and change management is notable.** These competences are critical for driving internal transitions. Similarly, competences in sustainable supply chain management, which are vital for reducing environmental impact, are not yet reflected in their profiles.

Embedding these skills into initial healthcare training is essential but fraught with challenges.

Several factors contribute to this complexity:

- **Overloaded curricula:** healthcare training programs, especially for nurses, are already dense, leaving little room to integrate additional topics like environmental health or sustainability without restructuring.
- **Absence of enough qualified teachers:** There is a lack of educators and researchers specialized in environmental health, a complex and interdisciplinary domain. This scarcity makes it difficult to develop and deliver high-quality training on these topics.
- **Resistance to change:** The entrenched focus on clinical and curative education may hinder efforts to prioritize those new topics in the curriculum.

The following solutions could help address these challenges to some extent and warrant closer evaluation .

- **Implementation of short, interdisciplinary modules:** Shared courses between institutions can optimize resources and ensure the coherent integration of sustainability themes into curricula. For example, the inter-university and high school certificate "Soins de santé durables : Agir pour transformer," offered by UCL, serves as an excellent model. Other formats, such as micro-credentials, MOOCs (Massive Open Online Courses), and online training programs, can also be utilized to provide flexible learning opportunities. The recent extension of nursing studies to four years is an opportunity to enhance workforce competence.
- **Collaboration with experts:** Partnering with experts in environmental health so that they can help train current faculty members. When possible, bring in guest lecturers to provide expert content on sustainability-related topics.
- **Engagement with professional associations and unions:** Working with organizations such as the Belgian Association of Hospital Directors (ABDH) and relevant unions is essential to promote these skills and facilitate training access, particularly for current healthcare directors and decision-makers.
- **Updating educational content:** To integrate eco-design, eco-prescription, and resource management into healthcare training in Belgium, collaboration between sectoral federations (e.g., FeBi), social funds (e.g., Vivo, Verso, Fonds Maribel Social), and other key stakeholders (e.g., unions such as ACV Puls, BBTk, the Order of Physicians, Domus Medica, and BVAS) is necessary. These actors must work closely with education and training institutions to update teaching and training content and ensure it aligns with the sustainability and environmental goals of the healthcare sector.

Continuous training – Continuing medical education (CME)

Continuous training is equally necessary to keep professionals prepared for evolving environmental demands.

In Belgium, continuing medical education (CME) is not compulsory. However, health professionals willing to be accredited must demonstrate they have collected a minimum of 60 credits points over a 3-year period. While this voluntary system provides opportunities for skills development, it could be significantly improved by addressing two key issues: first, **making CME mandatory**, and second, **incorporating new knowledge and skills essential for the healthcare sector's climate transition**.

Regarding the first point, the **FPS Health is working on reforms to introduce mandatory training hours for doctors**, potentially under a revised nomenclature. This measure would ensure that all health professionals systematically update their skills throughout their careers, aligning with the evolving demands of the sector.

To address the second issue, **universities and higher education institutions should work closely with key stakeholders in the healthcare sector to design and implement training modules that address the environmental impact of healthcare practices.** These stakeholders include healthcare institutions, professional associations representing nurses, caregivers, and physicians (e.g. the Belgian Association of Nursing Practitioners (ACN)), trade unions (e.g. the Belgian Association of Medical Unions (ABSyM)), and other specialized organizations (e.g. the Order of Physician). This collaborative effort should aim to incorporate sustainability principles into healthcare training at all levels, ensuring that professionals are equipped with the knowledge and tools needed to adopt environmentally responsible practices.

5.6. Policy considerations

To implement primary prevention

- **Increase the funding for primary prevention, as currently only around 1.6% of healthcare budgets is allocated to it (OECD and European Observatory on Health Systems and Policies, 2021).** This is mainly a competency of the regions in Belgium. In addition, key institutions such as Sciensano and RIZIV-INAMI lack climate–health units. Further, implementing primary prevention is complicated with regard to reaching underserved populations, particularly those with lower levels of education. For instance, over 80% of people in Brussels with lower education levels do not have a general practitioner, limiting their access to preventive care¹⁷.
- **Governments, INAMI-RIZIV, trade unions, healthcare institutions and professional associations should work together to revise the reimbursement structures to better support preventive services.** This may include financially incentivizing health promotion activities, such as prescribing social engagements or encouraging time spent in nature.
- **The federal health administrations and health insurance funds could develop community workers to make sure vulnerable populations benefit from preventive care.** Indeed, vulnerable populations would benefit the most from a switch to preventive care (and therefore have a higher impact on the sector’s GHG emissions), as they (1) are more susceptible to chronic diseases, (2) often don’t consult their general practitioner.

To support secondary prevention

- **Prioritize targeted reforms and policy support to embed prevention as a central element of healthcare.** Measures such as promoting low-meat diets, encouraging active mobility, and fostering healthier lifestyles should be integral to treatment protocols. General practitioners, in particular, should transition from a prescription-focused model to becoming proactive guides for prevention-oriented behaviours. These changes are essential to ensure that preventive care becomes a cornerstone of modern healthcare practice.
- **Governments, trade unions, healthcare institutions and professional associations should work together to experiment with new cost-sharing models where healthcare providers are compensated based on health outcomes achieved, rather than time spent with each patient,** promoting quality of care over quantity. "Buurtzorg" presents a good example by focusing on holistic home care, close patient relationships, and empowering patients.
- **Healthcare facility managers can use the increase in preventive care to improve the working conditions of healthcare professionals,** with fewer hours devoted exclusively to treatment and more time allocated to health promotion activities. **This shift can help ease staffing shortages** by enabling flexible work hours and giving nurses the opportunity to engage patients in preventive care, which reduces recurring preventable issues and enhances job satisfaction.

¹⁷ Source: workshop

To support the decarbonisation of drugs and medical equipment

- **Advocate towards the European Medicines Agency (EMA) for an incorporation of environmental impacts into drug authorization processes.** Moreover, regulatory authorities and health insurers should mandate that suppliers disclose the carbon footprint of their products as a prerequisite for reimbursement eligibility, thereby incentivising eco-friendly practices and promoting low-carbon choices in healthcare.
- **Plead for a revision of ISO standards.** Indeed, Strict quality and safety regulations, including C-Sigma and ISO certifications, complicate adoption of circular practices.
- **Remove financial barriers and create financial incentives for the reuse of medical devices.** In Belgium, **health insurance** typically covers new medical devices, while reused ones often require patients to pay out of pocket. As healthcare facilities do not have sufficient financial means to experiment and plan significant investments, the **federal government** could lower the VAT on reusable products or offer federal grants to support the development of circularity. Since 2025, disinfection systems for reusable medical get an increased investment deduction. The federal government could also extend this deduction to other medical circular investments.
- **Review waste management regulation.** Waste management regulations also pose obstacles, especially for hazardous and infectious waste, which must meet contamination control standards. Although eco-friendly recycling solutions exist, Belgian laws mandate incineration of infectious waste, limiting sustainable alternatives.

To support the general evolution of practices within the sector

- **Foster the inner capacity of healthcare workers to be powerful drivers for change by massively raising healthcare's professionals awareness on climate change and their role in its mitigation in their initial and continued medical education. Sectoral funds can take these need for awareness raising into consideration in their education offer.** Stakeholders testify that once healthcare workers have been sensibilised to climate change, they are very prompt to changing their practices, in full coherence with their inner orientation towards "Care".
- **Increase the support to the sector's organisation around climate change issues.** Encouragingly, the sector has begun to organise itself in this regard, particularly in Wallonia and Flanders. It urges to generalize and support initiatives such as the one launched by Zorgnet-Icuro in Flanders. It plays a pivotal role for healthcare institutions by promoting quality care, advocating for sustainable policies, and fostering innovation. Zorgnet-Icuro has also taken steps to address sustainability within the healthcare sector, providing guidance and resources, such as their Sustacare which helps organisations implement sustainable practices and focus on key areas of environmental impact, empowering institutions to reduce their carbon footprint.
- **Generalise carbon footprint evaluation at healthcare facilities level, to define action plans.**
- **Lead by example.** Enforcing regulations that eliminate unhealthy food and drinks in vending machines and restrict unhealthy product marketing within hospitals and schools sets a standard for public health. Stakeholders point out that this might be difficult due to economic considerations of healthcare institutions. In absence of such regulation, **healthcare institutions** can take the lead by creating environments that promote healthy and sustainable choices, and thus influence behaviours while aligning their practices with broader decarbonisation and health goals.

6. Agriculture & Food processing

6.1. The transformation of the agriculture and food processing sectors to reach Belgium’s 2050 climate objectives

Scenarios for the agriculture sector to reach the 2050 climate objectives are very contrasted. It is important to understand their differences, as this contrast reflects in even higher proportions in the labour market demand. In a nutshell, for the agriculture production,

- the Core95 and BEH scenario lead to higher GHG emission reductions than the TECH scenario. This implies higher cuts in GHG emissions in other emission sectors and a slightly higher level of carbon sequestration through forestry and land-use to reach net-zero in the TECH scenario;
- the **TECH scenario** leverages technological innovation (precision farming, genetically modified crops);
- the **BEH scenario** focuses on profound shifts in behaviours (diets) and agricultural practices (significant development of agroecological practices) and
- the **CORE-95 scenario** activates similar behavioural levers at slightly lower ambitions than BEH.

For the food processing sector, to the best of our knowledge, no transition scenario exists in Belgium. The sector's direct emissions primarily result from processes and transportation. To assess the impact of the transition on employment in the sector, it is necessary to examine (1) how the transition of the agriculture sector could impact the domestic food production and (2) how the food market could evolve (end-demand, distribution channels).

Figure 4 below represents in a simplified way the possible transition scenarios for the food processing industry, based on the transition scenarios in the agricultural sector.

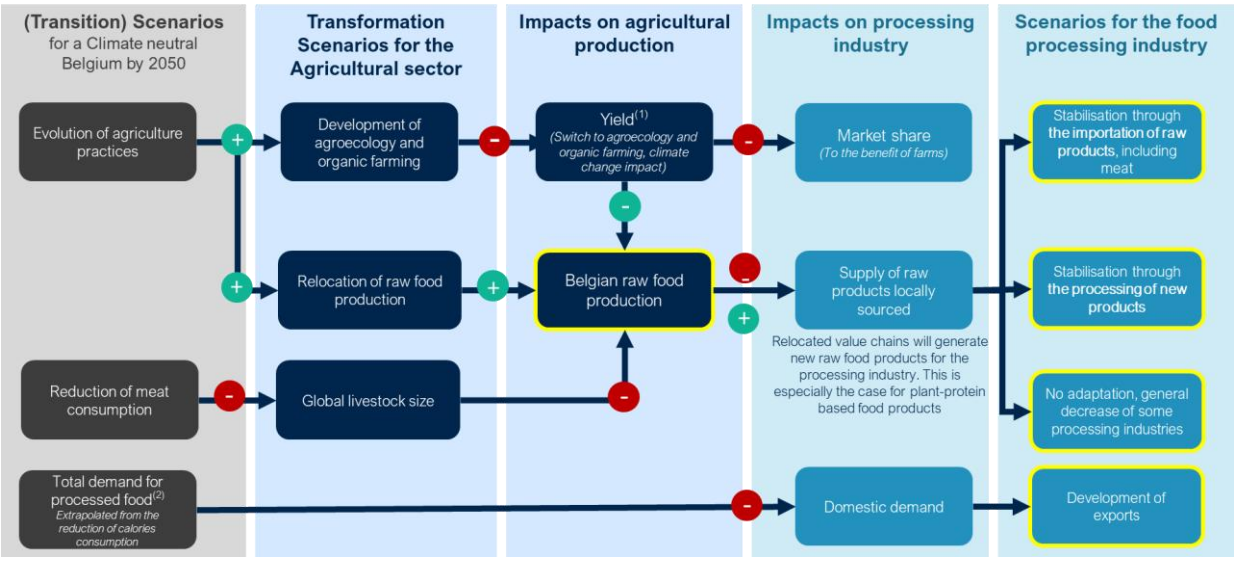


Figure 4 - Potential transformation scenarios for the food processing industry

We considered that a reduction in agriculture production would impact at an equivalent level the food processing industry¹⁸. Nevertheless, the food processing industry could leverage imports to keep a similar raw product input. Such a scenario would partially decouple the food processing industry to the transition of the Belgian agriculture sector. The compatibility of this scenario with a global net-zero objective is uncertain and would have to be carefully assessed¹⁹.

¹⁸ For example, a decrease of 30% of the meat production leads to a decrease of 30% of the meat processed by the sector.
¹⁹ To reach global net-zero, most countries’ meat production would have to be driven down.

The next two sections address (1) the transition levers that will directly influence activities and employment in both subsectors, and (2) the economic transformations likely to occur in the agriculture sector as a result of the transition, which form the basis for the impact assessment.

6.1.1. The reduction of meat and dairy consumption and the transformation of agricultural practices will radically transform the sector

The study focuses on the impact of two transition levers: (1) the reduction of meat and dairy consumption and (2) the transformation of agricultural practices. The impact of the evolution of food consumption, especially on the food processing industry, has very partially been estimated through a reduction in sugar consumption, for which hypothesis following the EAT-Lancet Commission's recommendation to reduce by 50% the quantity of highly processed foods and added sugars ²⁰.

Reduction of meat and dairy consumption

The scenarios propose distinct levers to reduce emissions by altering meat and dairy consumption. In all scenarios, meat consumption decreases, with the scale of reduction varying depending on the approach. Core95 focuses on a 56% reduction in meat, TECH relies on synthetic alternatives for more moderate decreases, and BEH emphasizes deep behavioural changes for even greater cuts in meat and dairy consumption.

- The BEH scenario advocates for profound behavioural changes, promoting steeper reductions in both meat and dairy consumption, particularly products from ruminant animals to free significant amounts of land for reforestation and ecosystem restoration.
- The TECH scenario leverages synthetic alternatives, including lab-based dairy products, to reduce reliance on conventional livestock, achieving more moderate decreases in traditional meat and dairy consumption while maintaining dietary diversity.
- The Core95 scenario reduces meat consumption by 56%, with the share of ruminant meat dropping from 21% to 13%. The EAT-Lancet Report (Food Planet Health) further recommends a 50% reduction in dairy consumption by 2050 to mitigate climate change, support sustainable livestock farming, and address potential health crises. Together, these shifts lower livestock numbers, reduce methane and nitrous oxide emissions, and free up land for carbon sequestration.

Transformation of agricultural practices with a direct impact on employment and skills

- Agroecology practices eliminate parts of or all synthetic fertilisers, which leads to different levels of crop yield reduction. The Core95 and the BEH scenario implement similar levers, with higher levels in the BEH scenario and thus higher reductions in crop yield.
- Livestock practices include extensification and increased grass feed. Intensive farming is scaled down, encouraging small-scale agroecology practices for higher sustainability and reduced livestock numbers.
- The TECH scenario emphasizes precision farming, genetically modified crops, and optimized resource use to maintain productivity while reducing emissions.

Other levers without significant direct impact on employment have not been factored in the analysis. Examples are the replacement of stock feeds by alternative protein sources requiring no crops, the development of the onsite production of energy, and the reallocation of the land freed from agricultural activities to carbon sequestration²¹.

²⁰ EAT-Lancet Commission (2019), Food in the Anthropocene: the EAT-Lancet Commission on healthy diets from sustainable food systems

²¹ The replacement of stock feeds by alternative protein sources requiring no crops, has no direct consequences on employment in the agriculture sector. It could however have indirect consequences if it comes with the development of local value chains, which could be further studied.

6.1.2. Activities within the sector could undergo either a marginal evolution or radical transformations

Unlike the other subsectors, the three transition scenarios can not be directly used to assess the transition's impact on employment and skills for agriculture. It was necessary to build additional **business transformation scenarios (LOW/INT/HIGH)**, directly linked to the three **transition to net-zero scenarios (TECH/Core95/BEH)**. These three (new) scenarios aim to reflect the consequences of the different GHG reduction levers on the sector's activity (type of farms, type of production). The transformation scenarios are defined by four transformation levers.

Figure 5 below shows the link between the transition scenarios and the transformation scenario that we built for the purpose of this study.

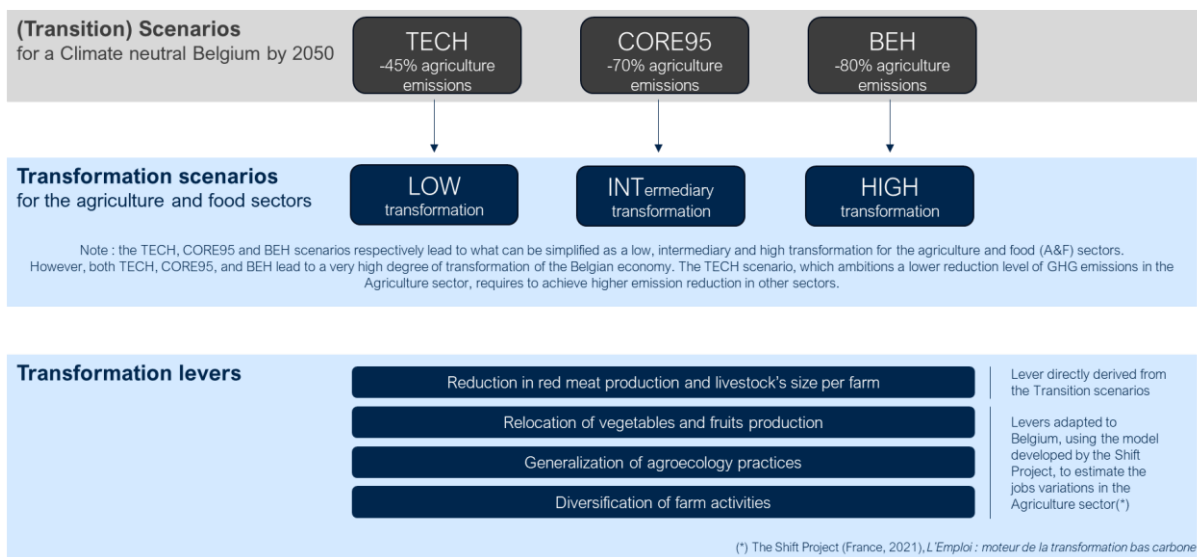


Figure 5 - Illustration of the link between transition scenarios and transformation scenarios

The transformation levers, outlined below, are based both on Belgian transition scenarios and on a proposal from a French study that examined the impact of the transition on employment across various sectors, including agriculture²².

- **Average number of heads per holding:** across all scenarios, the average number of heads per holding decreases, because of the decrease in the reduction in the red meat production.
- **Proportion of farms converted to agroecology²³:** in INT and HIGH, respectively 40 and 80% of farms are converted to agroecology. For these farms, we consider that the average size remains stable compared to the current one (38ha).
- **Self-supply rate for fruit and vegetables:** the study highlights the relocation of production chains and on-farm diversification as key strategies to reduce agriculture's climate impact and create local value.

The development of onsite production of energy could indirectly impact jobs by creating new income for farmers, thus increasing the capacity to hire. However, economic factors were not considered in this study.

All scenarios for the transformation of the agriculture sector include a reallocation of the land freed from agricultural activities to carbon sequestration. This reallocation is essential to offset the remaining emissions of the agriculture production. This reallocation was not factored in this study, considering a supposedly very low direct and indirect impact on employment.

²² The Shift Project (2021), *L'emploi: moteur de la transformation bas carbone*

²³ Agroecology designs sustainable agroecosystems by applying ecological and agronomic concepts and principles. Ecosystem services functional to crop growth (e.g. soil quality, pollination, natural pest control) are maximised through appropriate resource management and farming practices. The use of synthetic inputs is reduced to the minimum or eliminated. The nutrient cycle is closed at the farm gate or through exchange of inputs (e.g. manure) and outputs (e.g. feed) within neighbouring farms.

Furthermore, we consider that all new farms created to relocate this production would be 2ha in average, to factor in the cost of land acquisition.

- **Proportion of holdings that have diversified their activities** (onsite transformation and/or commercialisation of products).

Table 1 below lists the different variables associated to each lever and the values that we set for it in each scenario. Detailed assumptions for each variable can be accessed in the factsheet.

Table 1 – 2050 targets for each transformation scenarios (non-official targets, defined by CLIMACT for this study)

Transformation levers	Variables	2050 targets in transformation scenarios (Non-official, defined by CLIMACT)		
		LOW	INT	HIGH
Less production of red meat and reduction of the livestock's size per farm	Red meat production reduction (Bovines and pigs, compared to 2015 consumption)	-30%	-56%	-75%
	Average number of heads per holding's livestock	150	100	50
	Average number of pigs per holding (Wallonia)	800	533	267
	Average number of pigs per holding (Flanders)	1500	1000	500
Relocation of vegetables and fruits production	Self-supply rate for fruit and vegetables	13%	30%	50%
	Ratio of additional FTE for conversion of existing horticultural enterprises towards sustainable practices ^{(2) (3)}	1%	10%	15%
Generalization of agroecology practices	Proportion of farms converted to agroecology ⁽¹⁾	1%	40%	80%
Diversification of farm activities	Proportion of holdings that have diversified their activities ⁽¹⁾	1%	15%	30%

6.2. Labour market demand in terms of jobs

The numbers below are to be taken with most care. There are orders of magnitude to feed discussions with stakeholders and guide future developments. Providing very detailed simulations would require a much more complex technical economic modelling.

In a nutshell, the analysis led to two possible highly contrasted evolutions of the labour market, illustrated in Figure 6 and Figure 7 below.

- **Very high additional labour demand in Core95/INT and BEH/HIGH (+50,000 to +100,000 workers)** but with a net job loss in the food processing industry (-9,000 to -10,000 workers) with highly contrasted evolutions between jobs and reconversion opportunities to further explore and plan. Although these scenarios offer the most important gains in terms of GHG reduction and environment preservation, their impact on the job volume requires a strong, transversal and strategic planning.
- **Net job losses in a TECH/LOW scenario (~-2,000).** Job losses are observed across the whole value chain of meat-based food production. The few jobs created are not sufficient to offset these job losses.

Simulation of the total number of FTEs within the agricultural sector in 2050 for each scenario

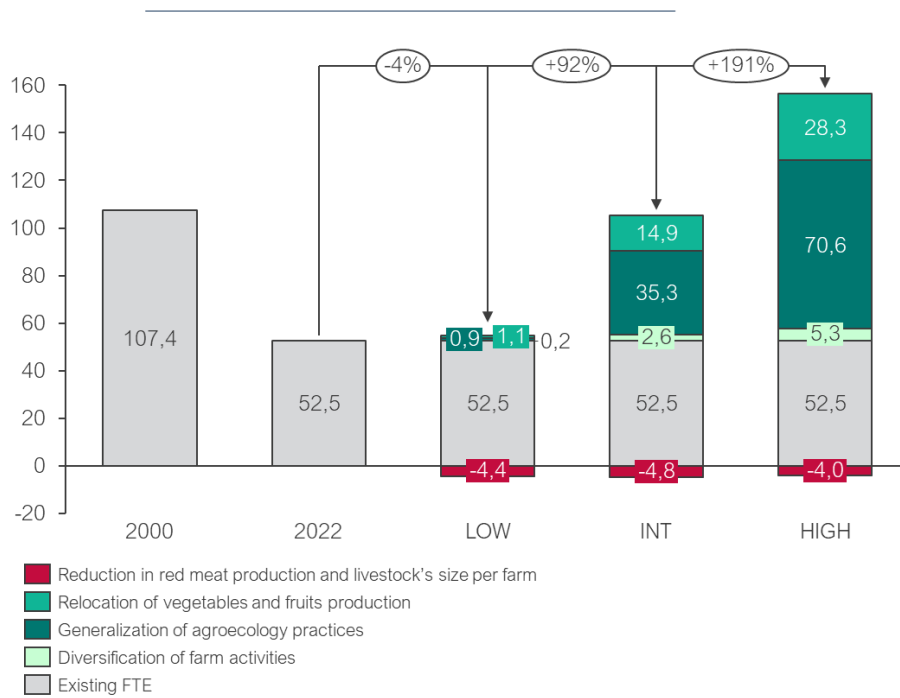


Figure 6- Simulation of the total number of FTEs within the agricultural sector in 2050 for each transformation scenario

Simulation of the total number of FTEs within the food industry sector in 2050 for each scenario

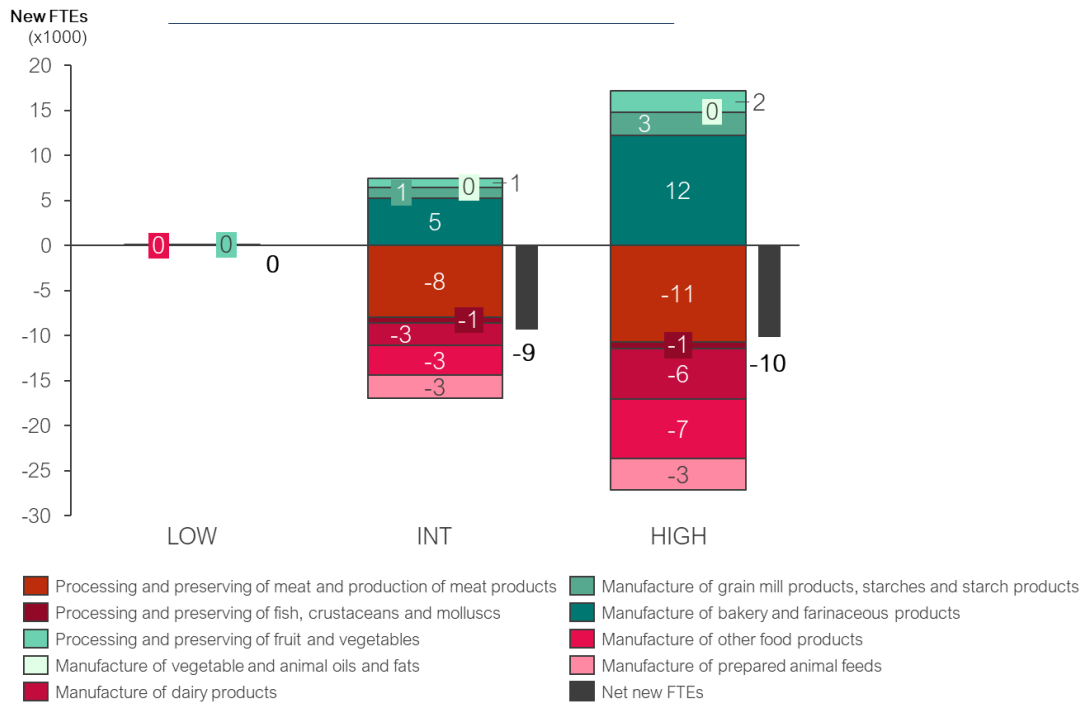


Figure 7 - Simulation of the total number of FTEs within the food industry sector in 2050 for each scenario

Overall, for the agriculture sector, the evolution of agricultural practices could require returning to the employment levels of the early 2000s

The net increase in workforce demand for field work mainly depends on the extent to which farms switch to agroecological practices, which are estimated to be four times more labour-intensive than conventional practices (four jobs would be needed for a 38-hectare farm, compared with one job at present). **We estimate that between 35,000 and 70,000 additional workers may be necessary**, mainly field crops and vegetable growers and mixed crops growers. The number of workers in the agricultural sector (52,000 in 2023) would need to almost double. Additionally, the relocation of vegetable and fruits production would require between 1,000 and 28,000 additional workers.

Decrease in meat consumption leads to job losses in both sectors, but is mitigated by extensive farming and smaller farms

The decrease in meat production could lead to a total loss, for agriculture and food processing together, between 4,400 and 15,800 jobs (between 2.5% and 9% of the 170,000 jobs identified in the sector):

- **between 4,000 (in HIGH) and 4,800 (in INT)** animal production jobs (livestock farm ploughers, livestock and day producers) and
- **between 0 (in LOW) and 11,000 (in HIGH) jobs** for activities linked to the processing and preserving of meat and production of meat products.

Two factors are key to limiting the job losses: the development of extensive farming and the reduction of the size of farms (in terms of number of animal heads).

Diet changes could lead to significant labour needs for bakery and farinaceous products manufacturing, an already dominant sector in terms of employment.

Between 7,000 and 17,000 additional workers (+35%) are required in HIGH, mainly due to an increased consumption (up to 50%) of bread, pasta, rice, and other cereals, of which the production already accounts for a high share of the current total employment for the manufacturing of bakery and farinaceous products (specifically bread and pasta production).

The reduction in sugar consumption recommended for health and climate issues could affect jobs in the manufacture of other food products. Employment in the subsector could fall by 30% in the case of high transformation (and by 15% in the case of intermediate transformation), depending on trends in sugar consumption in particular.

6.3. Availability of workers

Agriculture – some sectors in shortages

In agriculture, roles such as fruit cultivation workers (medewerkers in fruitteelt) and horticulture workers (tuinbouwmedewerkers) are also classified as shortage occupations by the VDAB²⁴. The scarcity stems largely from the physically demanding nature of these jobs, the seasonality tied to harvest cycles, and the low wages offered, making them unattractive to many potential workers. As vegetable and fruit production are relocated, so too will the demand for these roles, sharpening the observed shortage.

Food processing industry and workforce shortage

In the food processing, preservation, and manufacturing sector, Belgium's largest employer with the highest turnover and growth rate²⁵, labour shortages are acute across a variety of roles. These include bakery assistants, bakers, pastry chefs, chocolate makers, meat cutters, butchers and production line operators.

²⁴ VDAB– Beroepen in cijfers (2024).

²⁵ Enquête sur les forces de travail : publication détaillée 2023, <https://statbel.fgov.be/fr/themes/emploi-formation/marche-du-travail/emploi-et-chomage#figures>

A key issue is the mismatch between candidates' profiles and employers' expectations, particularly regarding technical expertise, soft skills, and work experience. Additionally, the physically demanding nature of these jobs, which often involve standing for long hours, exposure to extreme temperatures, irregular schedules, and relatively low wages, exacerbates recruitment difficulties²⁶.

Moreover, the sector faces shortages regarding STEM skills that could support R&D and innovation towards the transition, major companies being the main drivers for those changes. As most of the sector consists of SMEs (less than 100 employees), a specific role has to be developed through universities and colleges.

6.4. Labour market demand in terms of skills

The transition to more sustainable agricultural models has significant impacts on the labour market, far beyond the increase in workforce requirements. Changes in practices are highly complex and varied. They involve fertilization techniques, improving soil capacity to capture carbon, crop rotation, decarbonized antifungal practices, integrating ecological continuity elements into agricultural spaces, and the use of non-carbon fertilizers. These changes require significant reskilling. All agricultural and horticultural workers will need to upskill to adopt more sustainable practices.

A change in dietary habits implies a shift in farmers' professions

Transitioning from bovine to poultry farming (or other activities) or moving from intensive monoculture to diversified and rotating cropping systems **implies reskilling agricultural workers**. However, reskilling is expected to be challenging, as it often requires substantial investments and a fundamental reorientation of existing operations.

Upskilling should focus on the development of new technical skills

For all workers, upskilling should focus on the rational use of fertilizers and mastery of carbon capture techniques. Current occupational competency profiles for agricultural and horticultural workers, as well as their managers, broadly reference sustainability in terms of compliance with standards or promoting sustainable management. They lack concrete guidance on the technical more specific skills necessary for this transition. Agricultural workers can't independently identify or implement the necessary transformations in their activities. They **need to rely on specialized agricultural advisors for technical guidance on an on-site base**. These advisors, typically holding advanced degrees in agronomy or bioengineering, must possess a range of expertise, including:

- Conducting environmental impact assessments (e.g. life cycle assessments and audits)
- Advising on biodiversity conservation and protective measures
- Identifying and mitigating environmental risks.
- Recommending sustainable practices tailored to specific context

The transmission of know-how within a familial framework, weakened by the generational crisis

- The learning of the trade retains a largely informal component, primarily taking place within the farm itself. Traditional training systems are not inherently suited to reach such targets.
- Beyond the immediate shortages, the agricultural sector faces a **looming generational crisis**. A significant proportion of farmers are nearing retirement, with no clear successors to take over their operations (12% of farms have identified a successor in Flanders). The difficulty for farmers to pass on their farms within a framework of succession risks the potential loss of a powerful channel for transmitting know-how.

²⁶ Forem – Veille, analyse et prospective du marché de l'emploi (2024)

Integration of more profitable links in the value chain complexify the skill set of farmers

Relocation entails the incorporation of more profitable links in the value chain. While the financial and environmental stakes are evident, the type of skills that are added to the farming profession are largely exogenous to its original scope. Product development, compliance, marketing, sales, accounting, and logistics are all necessary specialized expertise to be integrated. While their occupational competency profiles mention packaging skills (e.g. labelling and conditioning methods), they fail to address critical areas such as sales and marketing expertise.

They can acquire these skills independently, seek guidance from specialized advisory organizations, collaborate with others through various organizational structures, or outsource the tasks entirely.

For those opting to handle these activities themselves, mastery of the following skills is essential:

- **Commercial skills:** establishing new sales channels, responding to public tenders, and effectively marketing their products
- **Processing skills:** adhering to HACCP standards, applying advanced processing and packaging techniques, and ensuring compliance with labelling and regulatory requirements

6.5. Training needs

The training system faces a dual challenge: (1) attracting and training newcomers to farming while (2) upskilling/reskilling existing agricultural workers and ensuring retention.

Bringing new talents into farming

To bring new talent into farming, targeted training programs for those without prior experience are essential, alongside campaigns that highlight the profession's purpose and meaningful impact. Stakeholders underline that farming is more than a job: it is a lifestyle demanding resilience, dedication, and a unique set of skills often passed down within farming families. Bridging this knowledge gap for newcomers requires innovative training approaches and a compelling narrative about the vital role of farming in society.

Addressing the succession crisis in agriculture also requires modernizing perceptions of farming. Communication efforts should focus on showcasing technological advancements and sustainable practices to inspire a younger and more diverse workforce. These efforts can position farming as a viable, impactful, and forward-thinking career path, ensuring generational continuity.

Reskilling and upskilling existing farmers

Reskilling and upskilling farmers through lifelong learning is essential but faces unique challenges. There are very different levels of qualification among farmers. Lower levels of formal education lead to low levels of participation in lifelong learning. Individuals with less formal education may feel less confident engaging in structured training programs or find them less accessible.

This reality underscores two main priorities:

- **Expand access to tailored training programs is crucial:** Formal training programs must be designed to equip workers with essential technical skills and support diversification. Formal training programs should provide essential technical skills and support diversification through short, seasonal, practical, and accessible formats. Sectoral funds are vital for their development and financing, addressing the needs of both workers and employers. Agricultural advisors also require specialized training to offer tailored, farm-specific guidance, ensuring precise assessments and targeted improvements for the sector's transition. An example of this approach is the 'KLIMREK' initiative, coordinated by ILVO, Boerenbond, and VITO.
- **Leverage informal learning pathways:** Informal learning is central to agriculture, as most workers acquire their skills through family or community networks and tend to trust their peers more than formal

educators. Strengthening these channels through mentorship programs, cooperative initiatives, and community-based learning will ensure that skill development aligns with the sector's practical realities and fosters trust among participants.

6.6. Policy considerations

- **Regional administrations should define transition plans for the agriculture sector, to give a long-term vision, plan investments and increase stability.** These plans should set science-based targets, plan the necessary changes in production and practices and further develop the employment and skills issues outlined in this study.
- **Research institutes, agricultural chambers and unions should mobilise their advisory capacity by developing a network of independent technical advisors,** in order to guide farmers through the transition, offering expertise, and supporting diversification efforts. Regional administrations can help to institutionalise this collaboration.
- **Regional administrations should develop independent technical guidance to farmers, daring to propose model conversions that are coherent with the transition targets defined at a regional level.** The current guidance provided to farmers is useful but shows certain limitations, both in terms of scale and the ambition it sets for change, as it focuses primarily on direct energy use and conversion to organic farming without addressing the production model itself.
- **The working conditions in agriculture, especially the wages, should be improved.** This implies an effort from all stakeholders, **including Belgian governments, the EU, sectoral organisations and the food industry** in order to promote agricultural professions through targeted training and outreach, ensuring the long-term viability of exploitation also in a shifted model.
- **Cooperatives and employer groupings** play a crucial role in sharing and pooling of resource, skill, and knowledge. These organizations foster collaboration across the value chain, from production to processing and sales, reducing costs and supporting sustainable, diversified business models. **Regional governments should facilitate and support these forms of organization** and collaboration in the agricultural sector.
- Beyond employment and training policies, **stakeholders recommend implementing support mechanisms to encourage the local consumption of meat produced through extensive practices.** One proposed instrument is a Carbon Border Adjustment Mechanism (CBAM) for agricultural products to address the current overshadowing of local production by low-cost imports.
- **Access to land is a key factor to ensure the redeployment of the profession. Public lands could be used to create farmer communities (thus leveraging this community to foster knowledge sharing)** or to provide free land, acting as a powerful tool for transformation within agriculture.

7. Research & Development

7.1. The contribution of the R&D sector to reach 2050 climate objectives

A data gap exists concerning R&D expenditures on climate-related projects. Interviewed stakeholders point out that neither the total amount of R&D spending on climate-related projects nor the actual impact of R&D on climate (i.e., linking R&D efforts to GHG reductions) can be accurately measured. This growing yet informal consensus is forming among EU public entities responsible for tracking R&D activities. The only viable approach remains ex-ante analysis of injected subsidies.

Nevertheless, existing studies and indicators show that a strong increase in R&D activities for climate change mitigation technologies is required to achieve climate-neutrality. Belgium ranks strong on environmental sustainability in the European Innovation Scoreboard²⁷, but only thanks to a strong score on resource productivity. Environment-related technologies are a weakness, which also shows in the Eco-Innovation Index²⁸ where Belgium is classified as a catching-up country. Despite the high total level of R&D personnel and researchers, Belgium has low government spending on environmental and energy R&D and weak performance in employment and value-added related to environmental protection compared to the rest of the EU.

To analyse the impact on jobs and skills, this study focuses on the development of technologies for which Belgium demonstrates above-average specialisation. To identify these technologies, a first list was drafted from a review of regional S3 strategies and interviews with CLIMACT's sectoral experts, with the objective to identify technologies with a low Technology Readiness Level (TRL) but high R&D intensity (therefore more susceptible to require significant highly skilled jobs). This list was then refined through an interview with Thomas Dermine's staff, then confirmed by workshop participants. No significant insight could be gathered concerning technologies for the food & AFOLU sector.

R&D effort for carbonated or energy-intensive technologies will progressively decrease by 2050. This impact has not been studied, due to time constraints.

Figure 8 – Key technologies for the transition. Key technologies for which R&D activities may significantly impact jobs and skills in Belgium are indicated in black.

²⁷ European Commission (2024). *European Innovation Scoreboard 2024: Belgium Country Profile*.

²⁸ Zomer and Bourneix (2022). *Eco – Innovation Country Profile 2022*

GHG EMISSIONS SECTORS	KEY TECHNOLOGIES FOR THE TRANSITION
TRANSPORT	<i>Electric light vehicles (vehicle efficiency, batteries, etc.)</i> <i>Charging infrastructure (charging speed, deployment, location, etc.)</i> Eco-design of batteries (end-of-life optimization) Hydrogen fuel cells <i>Road infrastructure (inland waterways, etc.)</i>
BUILDINGS	Construction/renovation techniques (bio-based materials, prefabrication, etc.) <i>HVAC technologies (heat pumps, solid biomass, etc.)</i> <i>Appliance efficiency</i>
MANUFACTURING	Low-carbon materials and recycling (steel, bio-based materials, concrete) <i>Electrification of processes (energy efficiency of equipment)</i> CCUS (infrastructure) <i>Industry 4.0 (IoT, digitalization of production processes)</i>
ENERGY PRODUCTION	Low-carbon fuel synthesis (e-fuels or biofuels) for heavy transport (maritime, aviation) or industry <i>Hydrogen synthesis (steam methane reforming, electrolysis, etc.)</i> <i>Photovoltaics (research on solar cells, etc.)</i> <i>Onshore and offshore wind (maintenance using IoT, etc.)</i> <i>Energy storage (batteries)</i> <i>Recycling chain (batteries, wind turbine blades, PV panels, etc.)</i> IT integration (EMS, PMS, smart grid)
Food & AFOLU	Precision agriculture and remote sensing <i>Fertilizers</i> Agroecological and regenerative agriculture techniques

7.2. Labour market requirements in terms of jobs

Given the impossibility to evaluate the current number of jobs dedicated to R&D for climate change topics, simulating forecasts would be not only quite complex but also irrelevant. Therefore, our analysis adopts a primarily qualitative approach. It specifically concentrates on R&D **expenditure in the business enterprise sector (BERD)**, which represents approximately **74%¹ of total R&D expenditure** in Belgium (GERD).

The analysis focuses on the two workers categories within the sector: researchers and supportive R&D personnel, whose mission is to provide scientific and technical support services (e.g. dedicated computing, library and documentation work, laboratory testing) as well as administrative support concerning financial and personnel aspects of R&D projects²⁹.

Additional researchers are needed, with both Masters' and PhD degrees.

- **Masters's degree profiles should keep growing, as a result of** the progressive (and already ongoing) orientation of R&D activities towards higher TRL, supported by increasing public funds support.
- **PhD profiles also benefit from this orientation.** PhD-holders are by definition trained for research and have additional analytical and technical competences that serve the purpose of any research agenda in the private sector. PhD-holders with some more experience can lead R&D Departments due to their deeper acquaintance with the 'research fabric'. Finally, PhD-holders usually keep a stronger connection to their research networks, which proves to be an important asset for future business R&D.
- **Next to technological R&D, many more researchers are needed in R&D in the human and social sciences**, with a view to gain a better understanding of the factors facilitating the (sometimes disruptive) evolution that are needed in social practices.

Additional R&D personnel needs to be hired to support the growth of researchers, regardless of whether the focus is on climate R&D or other areas, alongside the upskilling mentioned in chapter 8.4.

The distribution of R&D workers per sector is not expected to change. Manufacturing, professional, scientific and technical activities and information and communication concentrate almost 50% of the total R&D personnel and should remain the main drivers for employment and skills.

²⁹ BELSPO definition

7.3. Availability of workers in a context of workforce shortage

The sector currently suffers from a general STEM skills shortage which increases the pressure on the STEM skills needed for the transition (EU Commission, 2024)³⁰. This shortage (1) depends on lower working conditions and (2) may hit smaller companies harder, who drive most of the innovation on certain markets.

- **The shortage of PhD researchers with STEM skills, seems to be caused by** non-competitive salaries compared to other (non-EU) countries, the relative absence of large multinationals with their R&D headquarters in BE, an industrial structure focused on medium-tech products, and language issues. The relatively low and insufficient increase in the number of PhD profiles poses a **general risk to the sector's competitiveness**.
- **Smaller companies mainly depend on graduates from Belgian universities** (which have not fully integrated climate change issues in their programs - see Education chapter) **and may suffer even more from the “talent war”** whereas multinational companies can address the shortage by sourcing their talent on an international market. A recent report from Buildwise identifies this war as a crucial issue for the sector to deal with³¹. Even if the R&D effort is concentrated within a few big multinational companies, smaller companies account for a non-negligible share of the R&D effort, especially for construction materials and IT.

7.4. Labour market requirements in terms of skills

The climate transition generally increases the need for STEM-skills availability. In Belgium, these skills are specifically required for the transportation sector (mechatronic and chemical engineering), manufacturing (chemical engineering), building (material engineering), energy production (energy engineering) and IT.

Other skills will be required, whether the research is climate-specific or not. These skills fall into three categories: (1) research profiles dedicated to applied research (2) research profiles dedicated to high TRL phases (experimentation and industrialization), and (3) supportive R&D personnel with STEM or non-STEM skills.

Together with the growing need for master's degree workers, the sector will need additional profiles dedicated to applied research and integration of technology bricks, as public funding for R&D expenditure is more and more at levels TRL6+ (post-prototyping, demonstration, certifications, integration sub-systems in real environment, industrial upscale etc.). State aid rules have been revised at EU level by the European Commission (cfr revisions of so-called 'General Block Exemption Rules' (GBER)) three times since 2004, opening the possibility to public authorities to support R&D activities closer to market uptake at higher subsidization rates than before.

The supportive R&D personnel may require upskilling, to better support the regulatory and financial challenges of R&D projects. On the regulatory perspective, there is a need for a wider application of new legal instruments such as 'Contracts for differences' and 'Regulatory sandboxes' that help companies span long-run investment times. On the financial front, experts are needed (1) to strengthen business cases and reduce the “valley of death” risk and (2) in universities specifically, to better price and sell innovations, with the purpose to increase collaboration with the industry.

Additional workers with IT skills must be attracted to the sector. Digital tools are underused by the sector, yet they are a catalyst for R&D activities and essential to the sector's performance. This supposes organizational transformation within companies and universities to leverage these skills. Examples such as Solvay, which has set up an entire IT department dedicated to its R&D activities, or KUL, which is considering the same for CCUS research, are worth studying for replication opportunities.

³⁰ European Commission (2024), [Council recommendation on the economic, social, employment and budgetary policies of Belgium](#)

³¹ Buildwise, « Analyse de tendances et d'impact dans le secteur (belge) de la construction » (2023)

7.5. Policy considerations

The study did not manage to develop policy considerations for the R&D sector in terms of employment and skills.

More in general, there is a need to **invest into tools and methodologies to better target and monitor R&D efforts (investments, jobs and skills), with the aim to ensure that the public support is leveraging at its best.** For that, methodological and standardization challenges exist among innovation agencies. This increasingly becomes an issue of "research on research": how to define what R&D for climate mitigation and adaptation precisely is, how to monitor it, and identify market opportunities to support this direction.

The federal government should leverage existing tax incentives to promote sustainability-focus R&D and increase the attractiveness of research jobs. While public R&D efforts are increasingly taking the form of direct funding and tax incentives, the latter do not include any climate or environmental criteria. Improving researcher's remuneration, especially in universities, which is far less attractive in Belgium (and Europe) than abroad, notably in the USA, could help reduce the talent drain.

The federal government could help to create a market for certain sustainable products by sustainable procurement. Stakeholders indicate that in some cases the market might not be ready for more sustainable solutions. Although not relevant for all R&D, sustainable procurement can help to provide a first access onto the market.

Stakeholders point out that the pharmaceutical sector is extremely important when considering the Belgian R&D landscape. However, further analysis on the impacts of this specific subsector were not analysed.

8. Circular Economy

Initially, we considered the following NACE Codes within the scope of this chapter:

- 38 : Waste collection, treatment and disposal activities; materials recovery
- 39 : Remediation activities and other waste management services
- 77 : Rental and leasing activities
- 95 : Repair of computers and personal and household goods

The ambition was to have a specific focus on waste management, by assessing the impact of the reduction of waste streams on employment. However, due to difficulties in reaching the relevant stakeholders, the scope was modified. We chose to analyse the training needs to support the development of circular activities since many “circular jobs” are classified within the NACE code of the sector linked to the core business of the company, as Table 2 below illustrates. This supported our decision to look for the most critical jobs for each subsector based on the transition scenarios.

Table 2 – DISRUPT framework to categorise sectors and jobs, from the *Circular Jobs Monitor* (Circle Economy)

Type of jobs	Circular economy issues	Sectors
“Core” circular jobs	Prioritise regenerative resources	D – Electricity, gas, steam and air conditioning supply
	Sustain and preserve what is already there	C – Manufacturing G - Wholesale and retail trade; repair of motor vehicles and motorcycles R_S – Arts, entertainment and recreation, other services activities
	Use waste as a resource	E - Water supply; sewerage; waste management and remediation activities F - Construction G - Wholesale and retail trade; repair of motor vehicles and motorcycles
“Enabling” circular jobs	Rethink the business model	F – Construction N - Administrative and support service activities R_S - Arts, entertainment and recreation, other services activities
	Design for the future	M - Professional, scientific and technical activities
	Team up to create joint value model	R_S - Arts, entertainment and recreation, other services activities
	Incorporate digital technology	J - Information and communication

8.1. The transformation to a circular economy to reach 2050 climate objectives

In recent years, in the slipstream of the climate transition, the debate on the circular economy (CE) has remarkably gained traction. As one of the main building blocks of the European Green Deal it will reduce pressure on natural resources and it is a prerequisite to achieve the EU’s 2050 climate neutrality target (European Commission, 2019)³². For Belgium, it is estimated that two thirds of the total greenhouse gas emissions are linked to material-related activities, such as manufacturing, freight transport and building activities (FPS, 2021)³³. As

³² <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52019DC0640>

³³ Federal Public Service – Health, Food chain safety and Environment (2021), Scenarios for a climate neutral Belgium by 2050

such, the circular economy could contribute up to 32% of greenhouse gas emissions reduction by 2050. In particular, the following levers could be activated:

In the **passenger transport** sector:

- A decrease in car ownership and an increased occupancy rate of vehicles results in an exponential increase in car sharing services and memberships.
- Free floating electric scooter and bike activities keep on growing to support the modal shift.
- Bike maintenance activities increase exponentially while car maintenance activities decrease gradually, as discussed in Chapter 4.

In the **freight transport** sector:

- The demand for transportation reduces, because of a decrease in the amount of material transported over long distances.

In the **buildings** sector:

- The demolition rate increases across all scenarios (from 0,1% to 0,225%) because of the deep energy renovation of the building stock³⁴. This leads to the development of local material banks and value chains for transporting, storing and reusing deconstruction materials.
- The increase in material efficiency (between 8,5% and 85% across sectors) leads to the development of activities for the prefabrication, standardisation and industrialisation of buildings' elements production.
- The material switch leads to the development of low-carbon and biobased alternatives.
- The increase in recycling reduces the use of virgin materials to the benefit of reclaimed materials, which requires new digital tools to better manage the supply chain.

In the **industry**

- When implemented at ambitious levels, the modelled levers related to the circular economy lead to a reduction of materials demand of around 32% in the CORE-95 scenario and around 34% in the BEH scenario with respect to a reference scenario, while the reduction is of around 29% in the TECH scenario and 27% in the high demand scenario.

Agriculture

- Circular practices mainly consist in the development of on-site energy production.

8.2. Labour market demand in terms of jobs

Several studies using different methodologies already assessed the impact of the circular economy on the labour market. Therefore, this study does not aim at providing another quantification of the impacts of the development of circular economy, which would require significant modelling work to provide a significant added value to the existing results provided by the literature.

This study aims at discussing skills and training needs to support the development of circular activities. To support the discussion with quantitative elements, this section provides a brief literature review completed with an internal analysis, with the aim to scope the discussions on skills and training policies.

³⁴ For some of the worst performing buildings, a deep energy renovation without demolishing is not feasible from a techno-economic perspective.

As a result of the shift to a more labour-intensive sector, circular jobs have been growing exponentially, faster than predicted

In 2019, 7.5% of jobs (80,000 – direct and indirect) in Belgium were linked to circular economy and regions had a circular employment rate comprised between 5 and 9%³⁵.

In 2024, circular economy activities generated 45,000 direct jobs and 248,000 indirect jobs (Circular Jobs Monitor)³⁶ which in total accounts for 8,4% of the total jobs and represents a multiplication of the number of direct and indirect jobs by 2,66 between 2019 and 2024. Although the literature review didn't source any data for the direct jobs evolution, it is estimated that the increase rate is also high, yet probably inferior, depending on the leverage effect of direct circular jobs on indirect circular jobs.

This net creation of 213,000 jobs is more than two times superior to 2016 projections, which were foreseeing an additional need of 100,000 workers by 2030. This census scopes in jobs across all NACE codes and includes for example part of jobs within the production of renewable energy. Another study from the Circular Economy Policy Research Center of the Vlaanderen Circulair considers NACE codes similar to the ones scoped in this study. This methodological difference underpins the complexity to give a precise evaluation of the number of jobs within the circular economy. Indeed, for some companies, the current system of sectorial classification does not allow an adequate registering of circular economic activities³⁷

As outlined in a previous report from the FPS, jobs losses due to circular economy would mainly occur in fossil-fuel and material-extraction industries (FPS, 2023)³⁸. Jobs evolution within the fossil fuel industry is well documented and circular economy is not an important evolution driver. Material-extraction industries are not very present in Belgium.

Existing studies outline that labour demand for circular jobs will continue to rise, yet slower compared to last years' trend

When looking at the economic impact of circular economy development, studies generally forecast a light net increase in labour volume, although some jobs may be lost.

A meta-analysis over 300 circular economy scenarios (geographical scope not communicated) confirms the number of +1,6% jobs for ambitious circular economy scenarios compared to a business-as-usual scenario, with a very low standard gap (Aguilar-Hernandez et al., 2021). For Belgium, projections are coherent, as delivered in a study for the European commission, which projects an **increase in employment in circular economy between 0,3% and 1,6% by 2030³⁹ in Belgium** (Cambridge Econometrics et al., 2018)⁴⁰. Another study projected that a switch to circular economy could create 30k jobs by 2030 in Flanders (Willeghems & Bachus, 2019)⁴¹. The same study, although carried out on data sets from 2010 to 2016, identified that the circular economy employment index rises faster than the average Flemish, and that there were overlaps in the biggest employment potential, particularly in the machinery repair sectors (NACE_C - 33.1), rental and leasing (NACE_N - 77.2), and repair (NACE_S - 95.1 and 95.2).

³⁵ Fondation Roi Baudouin et Circle Economy (2019), *L'emploi circulaire en Belgique - Analyse de référence de l'emploi dans l'économie circulaire en Belgique*.

³⁶ <https://www.circular-jobs.world/>

³⁷ Fondation Roi Baudouin et Circle Economy (2019), *L'emploi circulaire en Belgique - Analyse de référence de l'emploi dans l'économie circulaire en Belgique*.

³⁸ Federal Public Service – Health, Food chain safety and Environment (2023), *Implications of the climate transition on employment, skills and training in Belgium*

³⁹ Price Waterhouse Cooper (2016). *Economie circulaire : potentiel économique en Belgique*

⁴⁰ European Commission. Directorate General for the Environment., Cambridge Econometrics., Trinomics., & ICF. (2018). *Impacts of circular economy policies on the labour market: Final report and annexes*.

⁴¹ Willeghems, G., & Bachus, K. (2019). *Modelling job creation in the circular economy in Flanders. CE Center Circular economy policy research center*.

Transition scenarios should strengthen this trend, with disparities between activities and subsectors

Some sectors already concentrate much more circular economy activities than others. In 2024, the sectors of wholesale and retail trade; repair of motor vehicles and motorcycles; electricity, gas, steam and air conditioning supply and Information and communication accounted for 72% of direct circular jobs.

Additional workers are mostly required within the “Core” circular economic activities of the DISRUPT framework (the ones that directly contribute to improving the material efficiency). These activities already account for 82% of direct circular jobs. We expect that this distribution at least will not change, or at most will strengthen. Indeed, for all sectors, more jobs should be created at the top of the Lansink scale (reuse/repair), as these jobs can hardly be delocalised. The analysis carried out for the Transport section further illustrates the tremendous volume of additional workers that would be required in repair.

For the “enabling” jobs, which account for the 18% remaining direct circular jobs, IT jobs are predominant (68%)⁴², and should continue to be, with a potential growth driven by new business applications for sectors where digitalisation remains low (construction, agriculture). In terms of circular jobs, the progressive development of eco-design within R&D activities requires an evolution of skills, with new conception methods and supply chains, but no necessary additional jobs.

For transportation, our analysis’ results partially differ from the literature, with both upward (bike mechanics) and downward (car mechanics) variations observed within circular jobs. To the best of our knowledge, existing studies have not modelled the impact of the transition on car mechanics, and the need for bicycle mechanics might be underestimated. The two other levers (development of shared vehicles and reduction of tons of material transported by truck) are not specifically developed by the literature that we analysed. The development of shared vehicles is not expected to require many more jobs, as it is a very low labour-intensive sector. The impact of the reduction of the tonnes.km of material contributes to the decreased demand for heavy truck drivers, as discussed in the transport section.

While renovation activities for reasons of energy efficiency and climate change are expected to have a positive impact on labour demand, **circular economy is not expected to significantly change the labour volume dynamics for the construction sector (FPS, 2023)⁴³. Productivity gains due to new practices could lead to job losses, which could be offset by the development of new direct jobs** (“valorist”⁴⁴, “inventorist”⁴⁵, for example). Undirect jobs creation, especially for the logistic sector that has a key role to play (creation of material banks, warehousing, etc.) would be worth further assessing.

For the industry, the material demand reduction would lead to a reduction in labour demand.

8.3. Availability of workers in a context of workforce shortage

Circular economy (CE) will contribute to some already existing skills shortages:

- Specific CE skills, such as repair of electronic devices and clothing, already suffer from considerable skills shortages.
- Technical profiles, with a wide range of sub-profiles (electronics, mechanics, ICT, engineering, operators, automation, etc.) and skills levels (high, low and medium-skilled profiles) are already facing serious shortages.

Transversal skills: our formal education systems are not always fit to deliver these profiles, and their increasing need is not only specific to the CE, but also to several other labour market trends, including the climate transition.

⁴² Circular Jobs Monitor (2024)

⁴³ Federal Public Service – Health, Food chain safety and Environment (2023), Implications of the climate transition on employment, skills and training in Belgium

⁴⁴ People responsible to valorize for reuse or repurpose what would have been a waste otherwise

⁴⁵ People responsible to inventory materials that can be reused on a demolition site

8.4. Labour market demand in terms of skills

The transition to a circular economy presents significant challenges for the labour market, driven by the redistribution of jobs both within and across sectors and the evolving nature of these roles. In addition, circular economy strategies rely heavily on labour- and skills-intensive processes, **requiring specialized expertise to effectively implement circular practices**. Employment in the circular economy predominantly consists of **low- and medium-skilled workers**, making it a vital growth sector with significant job opportunities for these groups. Moreover, the primary need is not **widespread reskilling across sectors but rather a targeted upskilling of the existing workforce** to equip them with the competencies necessary for a circular economy.

Building sector

In the building sector, circular practices demand targeted skill development to adapt **to new materials, construction methods, and value chain processes**. Architects, designers, and engineers must master **advanced design and construction techniques**, including prefabrication, standardization, and industrialized methods, while also becoming proficient **in using sustainable alternatives to traditional materials**, such as bio-based and ge-sourced options, to enhance material efficiency.

Transforming the demolition phase into a recovery and reuse phase will further necessitate the development of new skills in specific roles. **Emerging professions**, such as "**valoristes**" (waste recovery specialists), will be key to identifying, sorting, and recovering recyclable materials. Logistics professionals must develop skills in **reverse logistics** to manage the collection, sorting, and storage of deconstructed materials, facilitating their reintegration into the supply chain. **Certifiers** will require updated expertise to **assess and guarantee the quality of second-hand materials**, ensuring they meet reuse standards. Meanwhile, marketing professionals will need to develop **innovative strategies to promote and sell recovered materials**. This will involve addressing consumer perception challenges and designing effective sales techniques tailored to the second-hand building materials market.

Transport sector

In the transport sector, the rise of car sharing, free-floating scooters, and bicycles requires **both transversal and technical skills**. Sellers and customer service professionals must **enhance their communication, analytical thinking, and problem-solving abilities** to manage the growing complexity of these services.

Fleet managers need advanced tools to **optimize the allocation of vehicles**, ensuring demand is met efficiently, **while software developers play a critical role in creating platforms for real-time tracking, fleet management, and user-friendly interfaces**. The growing reliance on bicycles also drives demand for skilled repair professionals who can meet increased maintenance needs. In **freight transport**, logisticians must manage **very complex logistics systems** while software developers are vital for designing and operating them.

Industry sector

The **industrial sector** requires a profound transformation of skills across all levels, cutting across eco-design, functional economy models, and repair and maintenance practices.

Eco-design forms the foundation of this shift, demanding engineers, designers, and R&D teams develop expertise **in life cycle analysis (LCA), advanced material science, and modular product design to ensure products are durable, recyclable, and easy to repair**. These roles must collaborate with QHSE teams to **ensure products meet sustainability standards**.

Sales, marketing, and communication professionals play a pivotal role in supporting this transition by shifting from traditional product-centric strategies to emphasizing the environmental and economic benefits of circular solutions. **These teams must learn how to educate consumers, foster behavioral changes, and promote the value of repair, reuse, and service-based models over new purchases**. This requires not only communication skills but also a deep understanding of sustainability principles and the ability to connect them to customer needs.

Operational roles are also evolving, particularly in **logistics and purchase management**. Purchasing and logistics teams require knowledge and skills to ensure suppliers **comply with stringent environmental (and social) standards and that materials are fully traceable through the supply chain**.

In addition, the rise of **functional economy models**, such as Product as a Service (PaaS), further necessitates a shift in how businesses operate. Strategy managers and decision-makers must embed long-term thinking **into their operations, focusing on customer relationship management, product longevity, and the integration of service-based offerings**. Therefore, these leaders require training in collaborative leadership, environmental and social impact analysis, and new performance indicators tailored to circular economy goals. In such a model, **customer service teams become central**, ensuring seamless service delivery and **fostering long-term client relationships**.

Finance and accounting professionals must adopt performance indicators that prioritize medium- and long-term investments in service-based solutions while adapting accounting frameworks, which do not encourage the MT and LT investments needed for integrating service-based solutions or preventive maintenance systems.

In the area of **repair and maintenance**, industrial workers must gain **advanced skills in modular repair techniques, connected systems, and spare part management**. Repair technicians must also learn how to engage directly with customers, empowering them with the knowledge to maintain and repair products themselves, thereby extending product lifespans and reducing waste.

Across all these roles, **transversal skills** such as **collaboration, problem-solving, and systems thinking are critical**. These capabilities enable professionals to navigate the interconnected challenges of circularity, foster cross-departmental integration, and implement innovative solutions that benefit the environment and the business.

Agriculture

Biogas maintenance technician will be a key profession and become a growing job. Those technicians need to possess **the necessary skills enabling them to maintain systems that produce bioenergy**.

In the agricultural sector, biogas maintenance technicians will be a critical and growing profession as bioenergy systems become more widespread. **These technicians must possess strong mechanical and electrical skills to maintain and optimize biogas production facilities**. They must also have a solid understanding of **bioenergy processes and adhere to strict safety protocols** to manage risks associated with hazardous gases and high-pressure systems.

Collaboration with engineers, agricultural workers, and energy providers will be key, making this role central to the sustainable integration of bioenergy within the agricultural circular economy.

8.5. Training

The evolution of skills and jobs within the circular economy presents significant challenges for the training system. Addressing these challenges requires a focus on three primary areas.

1. Reskilling
2. Upskilling existing workforce
3. Enhancing initial training to ensure future workers are adequately trained

As mentioned, circular economy will primarily require a **general upskilling** of the workforce rather than widespread reskilling across sectors. Therefore, a proactive, collaborative approach between educational institutions, vocational training centers (VET), government bodies, and sectoral federations is essential to meet these demands effectively.

The systemic nature of the circular economy transition necessitates **holistic and collaborative approaches**. This requires fostering cross-departmental collaboration within industries by integrating design, production, logistics,

purchasing, and customer service functions while engaging external stakeholders such as suppliers. To ensure alignment and consistency, **all these actors should receive at least a basic level of training in circular economy concepts, enabling them to contribute effectively to the transition.**

Upskilling existing workforce through lifelong learning

Lifelong learning is critical for equipping the existing workforce with the skills required to transition to circular economy practices.

Upskilling efforts should primarily occur through on-the-job training or dedicated in-company programs, complemented by targeted programs offered by vocational education and training (VET) centers. These centers play a pivotal role by providing practical, hands-on experiences that address the specific needs of circular economy processes, such as eco-design, functional economy practices, repair services, and specialized careers like biogas maintenance. In this context, employees play an important role by training their workforce.

In addition, strong collaboration between companies and manufacturers is indispensable to keep pace with technological advancements, enabling workers to remain competitive and adaptable. For instance, in the repair sector, collaboration with manufacturers of some technologies and products are very important as provider of knowledge and repair training for their products.

Sectoral federations, such as AGORIA and Fedustria, must take the lead in coordinating these efforts. By acting as intermediaries between companies, training institutions, and policymakers, they can ensure that training initiatives are tailored to the specific needs of their respective industries.

For the functional economy, ongoing support mechanisms, such as business networks, incubators, and advisory bodies, should be emphasized. These provide leaders and professionals with opportunities to gain expertise **through practical experience rather than relying solely on formal education.** Training must also target support roles, including lawyers, accountants, and insurers, who are integral to operationalizing circular economy principles.

For repair services, **lifelong learning programs should reflect technological advancements and constant updates in product designs.** Repair professionals need continuous skill development to handle modular and connected devices while improving product repairability. These programs must also address structural **challenges in the repair sector, such as low wages and poor working conditions, by creating incentives that make these jobs more attractive and viable.**

Enhancing initial training to ensure future workers are adequately trained

While lifelong learning is essential, initial training forms the foundation for equipping future workers with the competencies needed for the circular economy. Curricula must be updated to include skills for both emerging and existing roles, ensuring alignment with circular practices.

Moreover, for learning activities to align with company needs, also informal collaboration (such as internships, development of learning materials, training of educators...) between schools, training providers, sectoral funds and companies is essential.

For **emerging roles**, such as "valoristes" (waste recovery and sorting specialists), training centers must recognize and formalize these professions through dedicated programs and certifications. Currently, many training institutions are reactive, focusing on short-term market needs rather than anticipating future trends. This lack of foresight hinders the development of training pathways for critical roles like "valoristes". A proactive approach is essential to ensure these roles are valued and supported.

For **existing roles**, including architects, designers, engineers, construction workers, and repair technicians, initial training must be updated to reflect the competencies required for circular practices. In the building sector, this includes integrating modules on eco-design, alternative materials, prefabrication, standardization, and industrialized construction techniques. For the industrial sector, engineering programs must incorporate life-cycle

analysis (LCA) and material sustainability into their curricula, enabling future engineers to design products that are durable, modular, and repairable. For the repair sector, training must strengthen foundational skills in electronics, electricity, electrotechnics, computer knowledge, and soldering to ensure professionals can perform precise repairs and improve product repairability.

Initial training should also include non-technical disciplines, ensuring that support roles such as legal, marketing, and sales professionals gain a solid understanding of circular economy principles and their practical application in business operations, through their education.

8.6. Policy considerations

- **Sector-specific experts from the industry and educators should develop** curriculum frameworks and training programs tailored to the needs of the circular economy, for example through sector-specific working groups.
- **Initial education institutions should update curricula across all education levels to integrate circular economy concepts, ensuring that future workers are equipped with the necessary skills from the outset.** Revise educational programs for architects, engineers, designers, and technicians to include circular economy principles such as life-cycle analysis, eco-design, and sustainable materials. Incorporate specialized courses or certifications in emerging roles.
- **Formalize and institutionalize emerging roles**, by establishing recognized certifications and educational programs. Work with training institutions and sectoral federations to create dedicated training pathways for new circular economy roles, ensuring these positions are integrated into formal education and career progression systems.
- **Integrate circular economy principles into non-technical training programs, such as law, marketing, and finance, to ensure that professionals in support roles understand the operational aspects of a circular economy.** Develop specialized modules or certification programs for professionals in legal, accounting, and marketing sectors, providing them with the knowledge to advise businesses on circular economy practices and policies.
- **Offer specialized, continuous professional development programs for repair technicians, ensuring that they stay up-to-date with new technologies and product designs.**
- Additionally, create incentives to improve job conditions and wages in sectors such as repair services, which may face challenges in attracting workers. For some jobs, it can be useful to integrate them in a better joint committee.
- **The federal government could increase funding and support for on-the-job training programs, ensuring that companies are incentivized to provide practical, hands-on training in circular economy-related fields.** This could include government-backed subsidies or tax or parafiscal incentives for companies that offer training opportunities.
- **The federal government could implement a tax shift, from labour to extraction**, to increase the economic competitiveness of reclaimed material over virgin resources while creating a tax incentive targeted on employment for companies who shift to circular practices (Mossay & Peters, 2024)⁴⁶.

⁴⁶ E. Mossay & A. Peters (2024), *Contribution sur le prélèvement des ressources minérales (CPRM). Vers un « principe préleveur-payeur » ?*

9. Education and training

9.1. An educational chain from awareness to technical content

To achieve a successful net-zero transition, education and training systems must focus on the development of "sustainable competences". These ones include attitudes ("willingness"), skills ("know-how"), and "specific knowledge" related to green skills and jobs, aimed at promoting sustainability. These dimensions must be systematically nurtured at different stages of the educational journey, from primary school to lifelong learning, with distinct emphases at each stage.

The figure below shows how those dimensions can evolve over time and influence the design of programs at each stage of the education system.

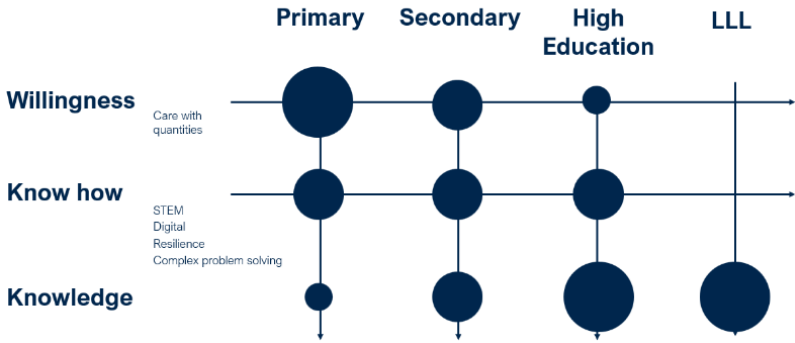


Figure 9 – Degree of inclusion of each dimension into educational programs, according to the stage of the education system

In **primary education**, the focus is primarily on fostering "willingness". This means raising awareness and developing an understanding of environmental challenges while inspiring a desire to take action. Cultivating care for resources and a sense of responsibility forms an essential foundation that accompanies individuals throughout their lives, shaping how they engage with sustainability in both personal and professional contexts.

As students' progress, the development of **skills ("know-how")** becomes a central pillar of their education. These include both complex general skills, such as those linked to STEM disciplines, and transversal abilities like systems thinking, critical thinking, adaptability, problem-solving, and creativity. These competences are equally critical at every stage of learning, from primary school to higher education, as they form the foundation for addressing low-carbon transition challenges and succeeding in a competitive, digitally driven labour market.

In higher education, "**knowledge**" takes centre stage, encompassing the technical and practical expertise needed for green skills and job. While this foundation is introduced in primary education and expanded in secondary education, it reaches its fullest potential in higher education, where students are equipped with the specialized expertise needed to meet labour market demands. The more distinctive and industry-specific these skills become, the closer they align with trade secrets. At this stage, their development often shifts to companies, with public authorities supporting innovation through research funding within businesses.

Lifelong learning (LLL) plays a critical role in maintaining the relevance of these specialized skills for individuals already in the workforce. By offering opportunities to update and refine knowledge, LLL ensures professionals can adapt to new challenges and innovations. For green jobs, where expertise must evolve alongside technological and environmental advancements, continuous learning mechanisms are indispensable. As green

roles demand increasingly specific competencies, companies are more likely to integrate skill development internally through targeted training and upskilling programs. This approach ensures employees remain competitive and effective, supporting both organizational success and broader sustainability goals.

9.2. Labour market requirements in terms of skills

The transition to a “pedagogy of sustainability” will reshape **the roles and skillsets required of educators and trainers.**

Compulsory education and secondary education

In compulsory education, teachers need to foster “willingness” among students to engage with **the climate transition challenges.** To do so, they will need **to acquire foundational knowledge related to climate and social transition.** This includes understanding key concept such as (non-exhaustive list):

- Causes, consequences and solutions to climate change
- Multidimensional implications of climate change (environmental, economic, social)
- Practical pathways towards the transition (sufficiency, energy efficiency, renewable energy, innovation, sustainable agricultural/mobility/urban/.. practices,)

Beyond knowledge, teachers must develop the ability to **foster essential transversal competencies (know-how) among their students.** These include (non-exhaustive list):

- **Systems thinking:** helping students analyse complex issues and understand how they are interconnected;
- **Critical thinking:** training students to question information, identify biases, and assess credibility;
- **Adaptability:** teaching resilience and flexibility to navigate uncertain and evolving circumstances;
- **Creativity:** encouraging innovative thinking to devise new solutions; and
- **Complex problem-solving:** promoting collaborative approaches to tackle multifaceted challenges.

To effectively teach these competencies, **educators will need to adopt new pedagogical skills suited to this multifaceted subject matter.**

Key approaches include :

- **Ensuring interdisciplinarity:** Teachers should recognize the systemic and interdisciplinary nature of climate transition. Therefore, primary school teachers should integrate these concepts across subjects, while secondary educators must overcome the traditional silos of their disciplines. For instance, a mathematics teacher might explore carbon footprint calculations, a French teacher could assign readings on climate issues, and an art teacher might encourage projects like posters to raise awareness or creative expressions of students’ emotions regarding climate change.
- **Ensuring a critical learning approach:** Teachers should aim to profoundly change students perspectives, beliefs and behaviour through **reflecting on what we know and do not know.** It encourages them to question how they interpret their surroundings and the role they play in them.
- **Encouraging a whole school approach:** Stand-alone classroom learning activities contribute less to an action-oriented attitude. By **connecting different domains** (not only education, but also school policy, school design and the school environment), a more powerful approach is created.

Examples of effective pedagogical practices :

- **Active learning:** Encouraging practical engagement through activities such as recycling workshops, role-play, research projects, hands-on experiments and simulations
- **Student-centered, design-based, project-based, transformative (situated) learning contexts**
- **Facilitation skills:** Leading discussions, moderating debates on complex issues, and fostering a safe space for diverse ideas

- **Managing eco-anxiety:** Given the emotional weight of climate-related topics, educators must learn to address eco-anxiety and feelings of powerlessness among students, providing them with constructive ways to process and respond to these emotions

Overall, the role of teachers transcends the traditional boundaries of knowledge transfer. They must evolve into mentors who inspire students to apply their skills meaningfully, engage with real-world sustainability initiatives, and contribute actively to building a resilient and fair future.

Higher education

In higher education, educators will also need to acquire new skills to address these challenges. As with primary and secondary school teachers, they will play a critical role in fostering further awareness (willingness) and equipping students with essential transversal skills (know-how). In order to do so, they will also need to acquire the skillset developed above for the primary and secondary teachers.

However, higher education also needs to delve into the **knowledge** required for the transition. This includes understanding how the low-carbon shift will give rise to new jobs and competencies, often referred to as "green jobs." Teacher-researchers, as experts in their fields, will need to **adapt their expertise to incorporate these emerging demands, ensuring that their teaching remains relevant and forward-looking.**

Another critical aspect of higher education is addressing the inherent uncertainties and complexities of the knowledge being taught, particularly in evolving areas. This requires a strong **foundation in epistemology, enabling educators to reflect on how knowledge is produced, validated, and shared.** Presenting scientific uncertainties and controversies thoughtfully can encourage students to engage in critical thinking and develop a balanced understanding of complex topics.

In addition, **educators must develop foresight skills to anticipate and prepare for how jobs and competencies linked to their subjects might evolve.** Moreover, by integrating prospective thinking into their teaching, they can guide students in navigating rapid and unpredictable transitions.

To make these complex topics accessible, **educators will need to diversify their pedagogical approaches.** This includes employing innovative teaching methods such as experiential learning, collaborative projects, debates, and interactive lectures, etc.

Lifelong learning

Finally, **within the framework of knowledge development**, lifelong learning will be essential to equip the labour market with the evolving knowledge and skills required for the ecological transition. **Trainers will play a crucial role in reskilling or upskilling people.** To fulfil this role, they must themselves upskill to acquire the new knowledge and competencies they will need to teach effectively.

Trainers must be ready to adapt their teaching to dynamic and uncertain contexts. They need to help learners gain the expertise required for new professions or, when certain jobs disappear, support them in transitioning to entirely different fields. This will require a significant investment in training educators, ensuring they have the tools and understanding necessary to navigate such transitions.

The ecological transition also demands a systemic and interdisciplinary approach, which presents further challenges. Many educators are not accustomed to work across traditional disciplinary boundaries. It is therefore vital to equip them with the ability and confidence to teach **from an interconnected perspective, enabling learners to grasp the complexity of ecological and societal issues.**

9.3. Workforce shortage that plays against transversal pedagogy

The education and training sector is strongly fragilized by a significant shortage of professionals, including primary and secondary teachers as well as school leadership roles and adult trainers.

We emphasized that the "pedagogy of sustainability" relies on a shift from mere content transmission to the establishment of sustainable practices within schools. This widespread shortage, spanning from core roles to logistical ones, logically undermines the implementation of this cross-cutting pedagogy.

9.4. Training needs

To equip educators across primary, secondary, higher education, and lifelong learning contexts, with the skills and knowledge required for the ecological transition, substantial support is essential. This includes providing both initial training and lifelong learning to help them adopt new content and innovative teaching methods.

These training programs should be mandatory for all educators, regardless of their discipline, the type of courses they teach, or the level of education they are involved in.

Initial training

The initial training of teachers, whether for primary, secondary, or higher education, plays a pivotal role in shaping their teaching approach. However, these programs often **prioritize pedagogical methods tailored to specific disciplines** over in-depth exploration of the subject matter itself. For instance, teachers are trained in how to teach science classes but may receive limited exposure to the underlying scientific content. To address this gap, it is essential to incorporate topics related to the net-zero transition into teacher initial education program. This integration should go beyond standalone lessons, embedding these topics within interdisciplinary pedagogical strategies.

Lifelong learning

In addition to initial training, lifelong learning is essential for equipping educators (and trainers) with the new skills and knowledge required. This includes fostering awareness (willingness), practical skills (know-how), and (green) knowledge. Stakeholders emphasize the importance of lifelong learning, given the time gap between the initial training of teachers and the entry into labour market of their first students.

In order to reinforce lifelong learning, **strong support from leadership at all levels** is necessary to:

- Develop a clear vision: establish a coherent strategy for integrating sustainability into long-term educational projects.
- Implement lifelong learning: ensure teaching staff have access to structured lifelong learning programs, along with the necessary resources and support to effectively teach new and evolving subjects.

To achieve this, **school principals should participate in training programs** designed to equip them with practical tools and resources for integrating sustainability topics throughout their institutions and across the curriculum.

In the *Federation Wallonie-Bruxelles*, teachers and school staff are required to complete six half days of professional training annually. Additional voluntary courses are available for those seeking further development. In the Flemish Community, each school must create an annual training plan, specifying objectives and budgets for professional development. These plans often prioritize key competencies based on the institution's goals.

To address current challenges, these training hours should include modules focused on *willingness, know-how, and knowledge* specific to sustainability. **Policymakers must provide clear directives to institutions such as the Institut de la Formation en cours de Carrière (IFCS), school networks, and school administrations to integrate these themes into lifelong learning.**

Overcoming time constraints

One of the primary obstacles today to teach these new courses are the limited resources available to schools and teacher training programs. Funding, personnel, and time are often insufficient to support meaningful changes. To address this, **training institutions** should offer flexible and accessible training options, including:

- **Short-term professional development courses:** Targeted workshops to address specific sustainability-related topics.
- **Online platforms and MOOCs:** Digital tools that enable self-paced learning on climate and sustainability issues.
- **External experts:** Inviting specialists to deliver courses and provide reusable teaching materials for future use in classrooms.

Collaboration and peer learning

Centralizing and sharing educational resources, teaching methods and best practices are essential to enhance effectiveness. Collaborative opportunities for dialogue, experience-sharing, and mutual support among educators build collective expertise and confidence in tackling new challenges.

Universities should structure academic calendars to allow professors and researchers to engage in such exchanges, recognized as part of their professional responsibilities.

Examples of effective collaborative strategies include:

- **Pedagogical seminars:** Regular meetings for educators within the same discipline or institution to discuss teaching methods and course development.
- **Expert-led conferences:** National events featuring specialists who provide insights into sustainability topics (*willingness*) and emerging skills/jobs (*knowledge*).
- **Research-based initiatives:** Programs encouraging collaborative projects between educators and researchers to develop innovative teaching methods through a combination of theory and practice.

Centralized resources

Finally, the content taught in schools must align with the official educational frameworks (*référentiels*) established by the Fédération Wallonie-Bruxelles and the Flemish Community. While teachers retain some flexibility in how they structure their lessons, having access to pre-established teaching materials and manuals is essential. These resources ensure that educators can deepen their understanding of complex issues and seamlessly integrate them into their existing disciplines. Therefore, it is critical to identify, develop, and share pedagogical resources. **A centralized platform should be created to house a wide range of materials, including lesson plans, teaching tools, and examples of best practices.**

9.5. Embedding transition-related content into educational frameworks

A key challenge in integrating sustainability into education is its **absence from national frameworks and minimum standards**. Without clear guidelines, teachers lack structured approaches to incorporate these topics, leading to inconsistent coverage. **Overcrowded curricula further limit opportunities to introduce new subjects** without displacing existing content.

To address this, sustainability must be embedded into curricula with clear entry points, ensuring seamless integration. Currently, climate and social transition topics are rarely addressed as standalone lessons in primary or early secondary education. In Flanders, for example, the key competencies (*sleutelcompetenties*) that underpin the learning objectives (*eindtermen*) include a category labelled sustainability (*duurzaamheid*) but it is empty. In the Fédération Wallonie-Bruxelles, competencies like *L'homme et l'environnement* (Human and the environment) exist but lack coherence across subjects, leaving teachers to bridge gaps independently, often with minimal resources.

Consequently, teaching sustainability largely depends on motivated individuals, as it is neither mandatory nor systematically supported. Existing references in frameworks, such as the *socles de compétences* in Wallonia and the *eindtermen* in Flanders, are fragmented and insufficient for meaningful integration.

Progress is underway. The Fédération Wallonie-Bruxelles is developing new reference frameworks for the *tronc commun*, explicitly incorporating climate and environmental issues across disciplines. Initiatives like the COREN program in Wallonia also support schools in implementing sustainability roadmaps, though these currently reach less than 1% of schools. Expanding such initiatives is essential to make sustainability a core part of education.

9.6. Transversal recommendations

- **Establish a cohesive framework.** Education on ‘willingness’ is currently not structured. Develop the learning objectives on sustainability to implement a unified framework for integrating sustainability into teaching. Ensure it provides clear guidance on how to include sustainability across curricula, whether through dedicated modules, interdisciplinary approaches, case studies... Tailor this framework to accommodate diverse educational contexts.
- **Education and climate administrations should centralize and coordinate sustainability initiatives and programs,** in order to reduce administrative burdens on schools. Streamline efforts to ensure schools can focus on implementing impactful actions without being overwhelmed by fragmented initiatives or excessive bureaucracy. This approach ensures operational stability while encouraging the gradual acceptance of reforms, reducing the risk of resistance from already overloaded institutions.
- **Create regional support networks.** Set up regional think tanks in Wallonia, Brussels, and Flanders to facilitate the exchange of best practices. Assign local experts to support school initiatives, offering direct assistance and tailored advice to schools. Clarify roles and responsibilities between regional and local governments to ensure efficient support. Such networks can centralise and spread information, such as the [KlasCement](#) platform does.
- **Schools should appoint a sustainability coordinator,** one for every primary and secondary school, replicating the Federation Wallonia-Brussels model in higher education. This role should focus on centralizing climate-related initiatives, mobilizing resources, and providing continuous support to teachers and administrators.
- **Support isolated educators.** Provide institutional recognition and dedicated resources to support educators driving sustainability projects. Ensure they are not left to work in isolation by embedding these projects into the school’s broader strategy and providing ongoing guidance and collaboration opportunities.
- **Expand and mutualize teacher training.** Consolidate and diversify the offer of continuous training programs at training sites. Provide teachers with more choices to address their specific needs and constraints, ensuring they are equipped to integrate sustainability into their teaching practices effectively.
- **Employers should put more effort into highlighting the need for green skills and developing occupational profiles in line with the climate transition,** for example in through the *service francophone des métiers et des qualifications*. These are crucial in order for employment services to develop relevant competency profiles and for education institutions to develop learning curricula. **New sectors should be better included** in this process, as new companies crucial for the transition are often not represented here.

10. Annexes

10.1. Annex 1: selection of the subsectors

Subsectors were selected through a three-stages process and iterative collaboration between the CLIMACT, IDEA, and FPS teams, with input from the study's follow-up committee members. The three stages were as follows:

- **Stage 1:** Creation of an initial list of priority subsectors based on criteria 1, 2, and 3 outlined in Table 1.
- **Stage 2:** Development of a preliminary selection based on criterion 4 (level of stakeholder engagement with the challenges) and 5.
- **Stage 3:** Final selection, using all criteria, from the subsectors included in the preliminary selection.

Fout! Verwijzingsbron niet gevonden. below outlines the criteria used to select the subsectors. While as much objective data as possible was used, some estimates had to be made. The results of the criteria analysed serve as decision-making proxies rather than highly precise evaluations. Additionally, the focus was primarily on the current state of the subsectors, as economic forecasts for their development in terms of availability and quality are highly variable and depend on specific transition scenarios.

Table 3 - Criteria of selection for the subsectors

Criteria	Measured criteria	Data source
1. Current or projected weight for employment	Jobs volume > 20k	Statbel, BNB, ONSS
2. Size of the sector	Added value (weight and evolution)	Statbel, BNB, ONSS
3. Significant impact of the transition	Importance of physical and/or transition risks	CLIMACT assessment, based on a literature review and an expert judgment when data was not available
4. Low level of maturity regarding transition's issues	At a subsectoral level, availability and level of completion of transition roadmaps or dedicated studies Companies level of commitment (objectives certified SBTi)	Available roadmaps and studies Data collection from syndicates
5. High employment issues (volume and reskilling/upskilling)	Jobs shortages	VDAB, FOREM, Actiris ONSS

The following sections present the results of the analyses on stakeholder's maturity (10.1.1), risks (10.1.2), and economic factors (10.1.3Fout! Verwijzingsbron niet gevonden.). These analyses lead to a preliminary selection of subsectors, detailed in section 10.1.4. The analyses were conducted on a limited number of subsectors, excluding

those where further in-depth analysis appeared less relevant (due to minimal or no impact from the transition and/or very low employment levels).

The list of excluded subsectors can be found in 10.1.5.

10.1.1. Roadmap and sectoral studies benchmark outline high discrepancies between subsectors

Although a significant volume of sectoral studies and roadmaps exists, 75% of the 58 documents analysed contains little to no information demonstrating a thorough assessment of physical and transition risks, as well as the socioeconomic impacts on activity and employment. Moreover, this literature predominantly focuses on industrial sectors. Key sectors for the transition, such as agriculture, food, and public services (healthcare, water, waste management, etc.), are largely underrepresented. A score ranging from 1 to 3 was assigned to each document. The detailed results of this analysis, including the list of documents reviewed, are available in the Annex 3.

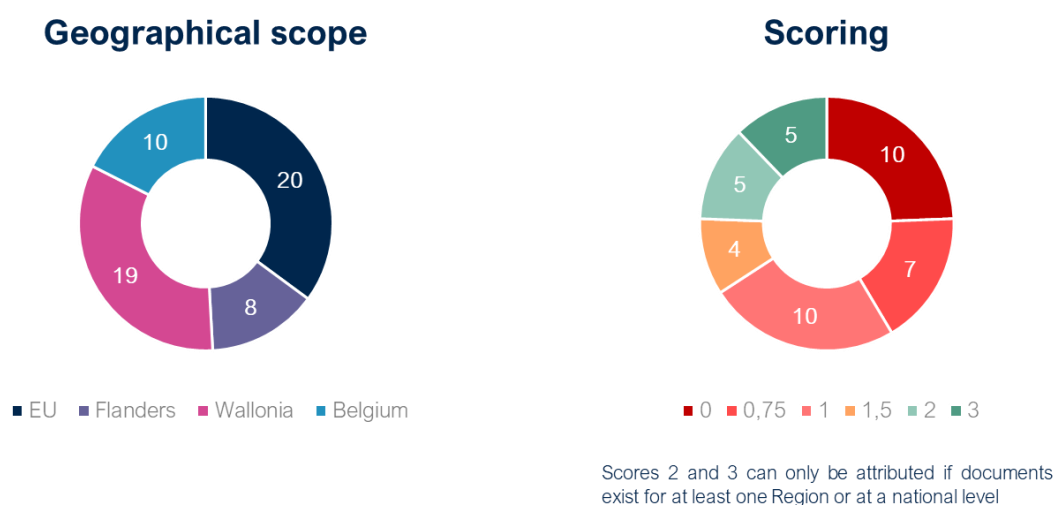


Figure 10 – Geographical scope and distribution of consolidated scores for each subsector

Fout! Verwijzingsbron niet gevonden. below lists the subsectors considered the most mature and therefore excluded from the selection. However, **two exceptions should be noted:**

- **The subsector Manufacture of other non-metallic mineral products (primarily the cement industry) was excluded despite having a relatively low estimated maturity level.** This decision was based on two factors. First, a substantial body of documentation already exists on the sector's transition, including an update to the FEBELCEM roadmap planned for this year. Second, we estimate that stakeholders and unions within this subsector are highly aware of the transition's impact. For prioritization purposes, it was deemed more relevant to encourage these stakeholders to build upon their existing or ongoing work rather than initiate new studies.
- **Automotive repair activities (part of subsector NACE code 29) were scoped in** due to their potential significant impact from the transition to electric mobility and their highly fragmented market, primarily composed of SMEs and micro-enterprises. Additionally, unlike other activities in subsector NACE code 29, these repair activities are not addressed in the transition scenarios developed by mobility sector stakeholders, including at the European level.

Table 4 - Subsectors with higher levels of maturity, left aside from the selection

NACE	Subsector	Maturity level assessment
23	Manufacture of other non-metallic mineral products	1
24	Metallurgy	2
20	Chemical industry	2
21	Pharmaceutical industry	2
22	Manufacture of rubber and plastic products	2
43	Specialised construction activities	2
19	Manufacture of coke and refined petroleum products	3
29	Manufacture and assembling of motor vehicles, trailers and semi-trailers	3
30	Manufacture of other transport equipment	3

10.1.2. Physical and transition risks assessment

Physical risks are direct threats or dangers resulting from natural phenomena or environmental conditions that affect the activities, employment, and training within subsector groups. Table 3 gives a non-exhaustive list of both physical and transitional risks.

Table 3 - Non-exhaustive list of physical and transitional risks

Physical risks	Transitional risks
<ul style="list-style-type: none"> • Flooding • Storms • Change in precipitation types • Drought • Loss of biodiversity • Water stress • Heatwaves • Temperature change • Resource depletion • Acute and chronic air pollution 	<p>Market risks with impact on production costs:</p> <ul style="list-style-type: none"> • Transition to lower-emission technologies • Increased raw material costs • Unsuccessful investments with impact on demand, type of activity, and production volume • Substitution of products/services • Uncertainty in market signals • Evolution of customer behaviour • Missed opportunities
	<p>Regulatory risks</p>

<ul style="list-style-type: none"> • Acute and chronic water pollution • Acute and chronic soil pollution • Ocean acidification • New pests and diseases • Fires • Changing wind patterns • Sea level rise • Soil erosion 	<ul style="list-style-type: none"> • Emission reporting obligations • Exposure to litigation • Pricing of GHG emissions through the emissions trading system (ETS) • Other regulatory developments
	<p>Reputation risks</p> <ul style="list-style-type: none"> • Stigmatization of a sector • Stakeholder concerns

Transition risks refer to the challenges and uncertainties a business or sector may encounter while adapting to economic, social, or environmental changes. These changes can stem from technological advancements, new government regulations, societal pressures, or shifts towards more sustainable economic models. Both physical and transition risks are assessed qualitatively for each subsector group. A score ranging from 1 to 3 is assigned for each type of risk, with 3 indicating the highest level of risk. The two scores are then multiplied, providing a comparative measure of the overall risk level faced by each subsector group.

10.1.3. Economic assessment

The economic analysis was based on simple, current data points: value added and employment figures. This approach was chosen to characterize the economic significance and labour market presence of the subsectors under study within the Belgian economy. For this, recent public data from Statbel and BNB were used and thoroughly examined. While regional distribution was also considered, it was not directly factored into the primary analysis.

Given the level of detail required for subsector analysis (down to NACE 3 codes) and the data sources available, certain proxies were employed, particularly relying on historical data from previous years. The reference year for this analysis is 2021.

To assess the economic impact, scores ranging from 1 to 9 were assigned to each subsector based on three main factors: the number of jobs, employment trends over the past decade, and value added. This scoring system enabled a comparison of the economic growth and significance of various subsectors. The results highlighted the growth of certain transversal sectors, such as legal, accounting, and management services, as well as rental activities. Additionally, sectors such as health and education remain major contributors to employment.

An additional layer of analysis focused on occupations in shortage, drawing from data across different regions. These shortages affect a broad range of subsectors, with varying levels of scarcity in different occupations.

The data was consolidated into a central table that presents the following key metrics: the number of jobs, value added, the proportion of subsector's employment relative to total regional employment, and the regional distribution of subsector jobs relative to overall subsector employment. This methodology provides a comprehensive overview of the current economic role of the subsectors, as well as their contribution to the Belgian economy and labour market.

10.1.4. Final selection

The **Fout! Verwijzingsbron niet gevonden.** 4 below outlines the final selection.

Table 4 - Final selection of subsectors

FACTSHEET	SUBSECTOR GROUPS (NACE)	Share of GDP ⁴⁷	Share of total employment ⁴⁸	JUSTIFICATION
1. Agriculture & food processing	<ul style="list-style-type: none"> Agriculture, forestry and fishing (1, 2, 3) Food processing (10,11) 	3%	3,7%	<p>The agriculture and food processing sectors are at the crossroads of multiple socio-economic and environmental challenges. Initially analyzed as separate sectors, they have been grouped together to present an integrated vision of developments along the agri-food value chain.</p> <p>Increasingly complex and difficult-to-manage risks threaten the resilience of the food system and food security. Agricultural production can suddenly experience drastic declines, triggering significant socio-economic consequences throughout the entire value chain. Moreover, this chain is expected to structurally shorten due to energy constraints (reduced reliance on fossil fuels) and shifts in consumption practices.</p> <p>However, depending on the transition scenario, these sectors could also present opportunities for varying levels of job creation. Furthermore, for both production and processing, the gradual introduction of "new" practices (such as agroecology and automation of production processes), products (like plant-based proteins), and regulations (on waste, traceability, etc.) raises skill-related challenges across all qualification levels.</p>
2. Circular economy	<ul style="list-style-type: none"> Environnemental services (36 to 39) Repair and rental (77, 95) 	3,6%	1,8%	<p>Relatively less exposed to physical climate risks (except for water management) and transition risks, these subsectors remain key for supporting the deployment of low-impact and circular practices (environmental services, repair, and rental)</p> <p>These subsectors offer significant job creation potential but will require investment in training and recruitment for emerging professions to realise this potential.</p>
3. Transport	<ul style="list-style-type: none"> Freight & logistic (46, 492, 494, 502, 504, 53) Passenger mobility (452, 491, 493) 	9,5%	7,7%	<p>While the technical challenges associated with the transition in the transport sector, from production to service provision, are well-documented, the socio-economic implications of this transition, particularly for service-related activities, have been relatively underexplored. In terms of goods mobility, the freight sector holds a central position in the Belgian economy and faces significant transition risks. Its steadily increasing activity is both a critical factor for business performance and directly influenced by transformations in other sectors (notably industry and commerce) and changes in overall demand for goods and merchandise. Structural changes in value chains—expected to shrink for some sectors (due to rising transport costs and environmental regulations) while remaining globalized for</p>

⁴⁷ Pour les sous-secteurs retenus

⁴⁸ Pour les sous-secteurs retenus

				<p>others—could have major implications for the geographic distribution of jobs and the required skillsets.</p> <p>In terms of passenger mobility, a modal shift towards active and shared modes of transport could create new employment and business opportunities, which the study aims to specify. Additionally, the electrification of the vehicle fleet could have significant impacts on repair activities, including reduced and altered maintenance needs.</p>
4. Health	<ul style="list-style-type: none"> Health (86) 	4,4%	7%	<p>The healthcare sector represents a significant economic weight, with nearly 350,000 jobs, accounting for just over 7% of total employment in Belgium. The exact greenhouse gas emissions generated by its activities are currently unknown, as they are distributed across other sectors (primarily mobility, buildings, and agriculture).</p> <p>Nevertheless, the healthcare sector plays a central role in the low-carbon transition. On one hand, it must and will need to adapt to the effects of climate change, which, if temperatures exceed 2°C, could impose significant organizational constraints to handle highly variable levels of demand. These challenges are further exacerbated by the sector's structural workforce shortage. Supporting the healthcare sector's adaptation to climate change is a crucial condition for ensuring its resilience.</p> <p>This may also require the development of new skills. On the other hand, healthcare professionals could act as ambassadors to the public, raising awareness and facilitating widespread understanding of climate issues. By supporting behavioral changes—such as encouraging the adoption of active mobility—the sector could play an indirect yet impactful role in reducing greenhouse gas emissions.</p>
5. Education & training	<ul style="list-style-type: none"> Education & Training (85) 	7%	8,6%	<p>Less than 5% of university courses address climate and environmental issues⁴⁹. Overall, more than 60% of higher education courses in Belgium make no reference to these topics. While no equally precise figures are available for lifelong learning, the same observation applies. Although no comprehensive meta-analysis has been conducted to date, sectoral studies highlight examples demonstrating the lack of lifelong learning and technical training on climate and environmental issues (for instance, in the construction sector, several studies reveal that the skills needed to address challenges such as deep energy renovation and circular economy practices are insufficiently integrated into training programs)</p> <p>The training of trainers/instructors is a necessary condition for implementing a transition pathway that will lead Belgium to achieve net-zero emissions by 2050.</p>
Transversal - Others	<ul style="list-style-type: none"> R&D 	5%	4,7%	<p>These two transversal themes are key to the success of the transition. While R&D is documented by sector, there is little cross-sectoral documentation available. Legal,</p>

⁴⁹ THE SHIFTERS BELGIUM, *Mobiliser l'enseignement supérieur pour la transition vers la neutralité carbone*, 2022

	<ul style="list-style-type: none">• Legal, accounting and management activities			accounting, and management activities are rarely addressed in transition plans. However, training professionals in these fields on these issues is essential to accelerate the transition of businesses. This highly heterogeneous group will be further detailed in the next phases of the study.
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10.1.5. List of analysed subsectors during the selection process

Codes NACE	Branche d'activité	Volume d'emplois (en milliers)
1	Culture et production animale, chasse et services annexes	56,6
2	Sylviculture et exploitation forestière	2,3
19	Cokéfaction et raffinage	4,7
20	Industrie chimique	42,9
21	Industrie pharmaceutique	27,3
22	Fabrication de produits en caoutchouc et en plastique	25,6
23	Fabrication d'autres produits minéraux non métalliques	27,2
24	Métallurgie	26
25	Fabrication de produits métalliques, à l'exception des machines et des équipements	52
26,27	Fabrication de produits informatiques, électroniques et optiques	11
27	Fabrication d'équipements électriques	12,5
28	Fabrication de machines et équipements n.c.a.	29,7
29	Industrie automobile	30,2
30	Fabrication d'autres matériels de transport	6,7
31,32	Fabrication de meubles; autres industries manufacturières	21,9
33	Réparation et installation de machines et d'équipements	26
35	Energie	20,6
36	Captage, traitement et distribution d'eau	7,2
45	Commerce et réparation d'automobiles et de motocycles	76,4
46	Commerce de gros, à l'exception des automobiles et des motocycles	203,5
47	Commerce de détail, à l'exception des automobiles et des motocycles	311,6
50	Transports par eau	3,1
64	Activités des services financiers, hors assurance et caisses de retraite	56,1
65	Assurance	24,6
66	Activités auxiliaires de services financiers et d'assurance	35,6
68	Activités immobilières	30,4
71	Activités d'architecture et d'ingénierie; activités de contrôle et analyses techniques	63,2
72	Recherche-développement scientifique	12

74,75	Autres activités spécialisées, scientifiques et techniques; activités vétérinaires	25,9
77	Activités de location et location-bail	16,1
78	Activités liées à l'emploi	210,7
84	Administration publique et défense; sécurité sociale obligatoire	441,2
85	Enseignement	411,1
86	Activités pour la santé humaine	332
93	Activités sportives, récréatives et de loisirs	21,1
94	Activités des organisations associatives	44,2
95	Réparations informatiques et autres	4,6
96	Autres services personnels	70,7
05,06,07,08,09	Industries extractives et services de soutien aux industries extractives	2,6
10,11,12	Industries alimentaires, fabrication de boissons et de produits sur base de tabac	100,6
13,14,15	Fabrication de textiles, industrie de l'habillement, du cuir et de la chaussure	20,5
36,37,38,39	Collecte et traitement des eaux usées et déchets; récupération; dépollution et autres services de gestion des déchets	26,6
41,42,43	Construction	286,6
49,50,52,53	Transports terrestres et transport par conduites	121,9
49,50,52,53	Entreposage et services auxiliaires des transports	95,1
49,50,52,53	Activités de poste et de courrier	36,1
55, 56	Hébergement et restauration	158,9
61, 61	Télécommunications	22,8
62, 63	Programmation, conseil et autres activités informatiques; services d'information	83,2
69,70,	Activités juridiques et comptables; activités des sièges sociaux; conseil de gestion	401,1
80,81,82	Services relatifs aux bâtiments et aménagement paysager Enquêtes et sécurité; services relatifs aux bâtiments et aménagement paysager; activités administratives et autres activités de soutien aux entreprises	228,2
87, 88	Action sociale avec et sans hébergement	315,9
90, 92	Bibliothèques, archives, musées et autres activités culturelles; organisation de jeux de hasard et d'argent	26,6
97, 98	Activités des ménages en tant qu'employeurs de personnel domestique et activités indifférenciées des ménages en tant que producteurs de biens et services pour usage propre	40,9

10.2. Annex 2: Methodology of roadmap benchmarking

10.2.1. Roadmap collection

The roadmaps were collected through desk research by using roadmap-specific and subsector-specific keywords. This was performed in the 3 applicable languages: Dutch, French and English. The collection has been reviewed and enhanced by the SPF on a regular basis.

A total of 58 documents was collected, of which 46 were labelled as roadmap⁵⁰ and useful to analyse further.

10.2.1. Roadmap analysis

The key characteristics of each roadmap were extracted. This included:

- The author of the roadmap: a (sub-)sectoral federation or a public body.
- The geographical scope of the roadmap: regional, Belgian or European.
- The type of the roadmap: general, sectoral (NACE 1 digit), subsectoral (NACE 2 digits). In the case of a sectoral or subsectoral roadmap, the specific (sub-)sectors were specified.

Five criteria were assessed in each roadmap as “Yes”, “Partially”, “No” and “N.C.”⁵¹:

1. Are objectives formulated?
2. Is a plan established to reach these objectives?
3. Were stakeholders engaged in the creation of the roadmap?
4. Are climate risks assessed?
5. Are employment and skills risks assessed?

10.2.2. Scoring

Per subsector a score in the range of 0 to 3 was obtained concerning the quality/maturity of the available roadmaps (only the sectoral and subsectoral roadmaps). The higher the score, the more high-quality/mature the available roadmaps:

- 0: None of the five assessment criteria are fulfilled.
- 1: Less than three of the five assessment criteria are fulfilled.
- 2: Less than four of the five assessment criteria are fulfilled.
- 3: Four or more of the five assessment criteria are fulfilled.

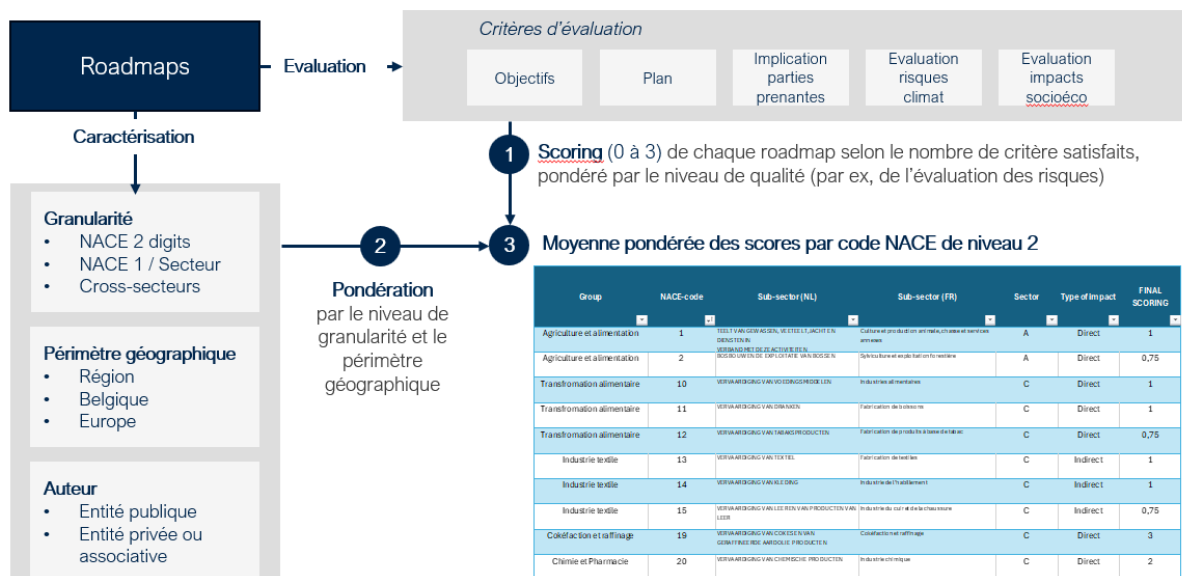
To take into account the difference in weight between (i) “Yes” and “Partially” fulfilled criteria and (ii) sectoral and subsectoral roadmaps the scoring above was further corrected the following way:

- If none of the five assessment criteria was given a “Yes”, the “Partially” were counted and the scoring was corrected with a factor 0.75.
- If for the subsector only sectoral roadmaps were available, the scoring was corrected with a factor 0.75.

The figure below schematises the methodology.

⁵⁰ A number of collected reports appeared to be rather an impact analysis than a roadmap, after a first quick scan.

⁵¹ Not Communicated.



10.2.3. Decision details

The goal of the roadmap benchmarking was to gain insights in the awareness/maturity of each subsector concerning the climate transition and its risks. Subsectors with an already high awareness/maturity (i.e. a high scoring) will not be analysed further in the following phases of the study. The table below lists the subsectors that will not be analysed further.

Table 5: List of subsectors with high-quality roadmap(s) available.

NACE code	Sous-secteurs	Estimation du niveau de maturité (/3)
12	Fabrication de produits à base de tabac	0.75
15	Fabrication de textiles	0.75
13	Industrie de l'habillement	1
14	Industrie du cuir et de la chaussure	1
25	Fabrication de produits métalliques, à l'exception des machines et des équipements	1
23	Fabrication d'autres produits minéraux non métalliques	1
24	Métallurgie	2
20	Industrie chimique	2
21	Industrie pharmaceutique	2
22	Fabrication de produits en caoutchouc et en plastique	2
43	Travaux de construction spécialisés	2
19	Cokéfaction et raffinage	3

29	Construction et assemblage de véhicules automobiles, de remorques et de semi-remorques	3
30	Fabrication d'autres matériels de transport	3
45	Wholesale and retail trade and repair of motor vehicles and motorbikes	3

Despite a low score, the first four subsectors from Table 5 (NACE codes 12 – 15), despite a low score, were removed from the selecting given their lower economic importance in Belgium.

25 - Manufacturing of fabricated metal products, except machinery and equipment

Despite a relatively low score of 1 (on 3) for the roadmap benchmark, it was decided to remove this subsector from the selection. Three subsectoral and three sectoral roadmaps are available for this subsector (Table 6 Table 7). The scoring was based on the 3 subsectoral roadmaps, of which two contained formulated objectives and an established plan. One roadmap assessed climate risks and employment and skills risks. With its close link to NACE code 24, which is removed too, it was decided to remove this subsector.

Table 6: List of available roadmaps for the Manufacturing of fabricated metal products, except machinery and equipment subsector.

Subsectoral roadmaps	Sectoral roadmaps	General roadmaps
(ADB1) Roadmap 2050 pour l'industrie technologique en Wallonie	Un écosystème industriel durable dans un monde qui évolue (Nouveau Position paper de l'UWE)	Green Skills Roadmap Flanders. Final Report on Green Skills Need in Flanders
LOW CARBON ROADMAP PATHWAYS TO A CO2-NEUTRAL EUROPEAN STEEL INDUSTRY	Naar een koolstofcirculaire en CO2-arme Vlaamse industrie	TOEKOMSTBEELDEN -Vlaanderen circulair in 2050
Metaal en klimaat - Hoe kunnen de metaalsectoren bijdragen tot een klimaatneutrale samenleving?	ERA industrial technology roadmap for circular technologies and business models in the textile, construction and energy-intensive industries	Plan de relance de la Wallonie
		Skills in transition - The way to 2035

23 - Manufacturing of other non-metallic mineral products

Despite a relatively low score of 1 (on 3) for the roadmap benchmark, it was decided to remove this subsector from the selection. Nine subsectoral and three sectoral roadmaps are available for this subsector (Table 7). The scoring was based on the 9 subsectoral roadmaps, of which four contained formulated objectives and engaged stakeholders. Three roadmaps contained an established plan, while two assessed climate risks and employment and skills risks. This reveals that the majority of the available subsectoral roadmap were of poorer quality, resulting in an overall score of 1. However, since there was still a good number of quality roadmaps available, it was judged that the score 1 did not reflect reality correctly and that this subsector could be removed given the level of maturity (a few quality roadmaps and overall awareness given the total number of roadmaps).

Table 7: List of available roadmaps for the Manufacturing of other non-metallic mineral products subsector

Subsectoral roadmaps	Sectoral roadmaps	General roadmaps
ROADMAP HORIZON 2050	Un écosystème industriel durable dans un monde qui évolue (Nouveau Position paper de l'UWE)	Green Skills Roadmap Flanders. Final Report on Green Skills Need in Flanders
(ADB5) Rapport de l'étude de FBB/FEDICER pour la réalisation d'une	Naar een koolstofcirculaire en CO2-arme Vlaamse industrie	TOEKOMSTBEELDEN -Vlaanderen circulair in 2050

Roadmap sectorielle 2050 ==>

Fédération de la Brique

(ADB 6) Roadmap ciment	ERA industrial technology roadmap for circular technologies and business models in the textile, construction and energy-intensive industries	Plan de relance de la Wallonie
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(ADB12) EVOLUTIONS POSSIBLES DU SECTEUR VERRIER WALLON À L'HORIZON 2050 DANS LE CONTEXTE D'UNE TRANSITION BAS CARBONE		Skills in transition - The way to 2035
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Boost de transitie: kantel het industriebeleid mee in de juiste richting

A Just Transition - CERAMIC ROADMAP TO 2050

Cementing the European Green Deal - REACHING CLIMATE NEUTRALITY ALONG THE CEMENT AND CONCRETE VALUE CHAIN BY 2050

TPEU - Chemical Industry

RAPPORT ENVIRONNEMENTAL DE L'INDUSTRIE CIMENTIÈRE BELGE 2022

24 - Metallurgy

Five subsectoral and three sectoral roadmaps are available for this subsector (Table 8). The scoring was based on the 5 subsectoral roadmaps, of which three contained formulated objectives and an established plan. Two engaged stakeholders and assessed employment and skills risks, while one assessed climate risks.

Table 8: List of available roadmaps for the Metallurgy subsector.

Subsectoral roadmaps	Sectoral roadmaps	General roadmaps
(ADB1) Roadmap 2050 pour l'industrie technologique en Wallonie	Un écosystème industriel durable dans un monde qui évolue (Nouveau Position paper de l'UWE)	Green Skills Roadmap Flanders. Final Report on Green Skills Need in Flanders
(ADB13) Roadmap 2050 pour le secteur sidérurgique wallon	Naar een koolstofcirculaire en CO2-arme Vlaamse industrie	TOEKOMSTBEELDEN -Vlaanderen circulair in 2050
LOW CARBON ROADMAP PATHWAYS TO A CO2-NEUTRAL EUROPEAN STEEL INDUSTRY	ERA industrial technology roadmap for circular technologies and business models in the textile, construction and energy-intensive industries	Plan de relance de la Wallonie
Metaal en klimaat - Hoe kunnen de metaalsectoren bijdragen tot een klimaatneutrale samenleving?		Skills in transition - The way to 2035
Skills roadmap voor de Vlaamse klimaattransitie. Focus op de energie-intensieve sectoren 2020-2035		

20 - Chemical industry

Four subsectoral and three sectoral roadmaps are available for the chemical industry (Table 9). The scoring was based on the 4 subsectoral roadmaps, of which the majority contained formulated objectives and an established plan. Half of the roadmaps involved stakeholders and assessed employment and skills risks. The assessment of climate risks was absent in all the subsectoral roadmaps. Overall, this led to a scoring of 2.

Table 9: List of available roadmaps for the Chemical Industry subsector.

Subsectoral roadmaps	Sectoral roadmaps	General roadmaps
Skills roadmap voor de Vlaamse klimaattransitie. Focus op de energie-intensieve sectoren 2020-2035 (ADB4) RAPPORT PUBLIC POUR LE SECTEUR DE LA CHIMIE ET DES SCIENCES DE LA VIE	Un écosystème industriel durable dans un monde qui évolue (Nouveau Position paper de l'UWE)	Green Skills Roadmap Flanders. Final Report on Green Skills Need in Flanders
Boost de transitie: kantel het industriebeleid mee in de juiste richting	Naar een koolstofcirculaire en CO2-arme Vlaamse industrie	TOEKOMSTBEELDEN -Vlaanderen circulair in 2050
TPEU - Chemical Industry	ERA industrial technology roadmap for circular technologies and business models in the textile, construction and energy-intensive industries	Plan de relance de la Wallonie Skills in transition - The way to 2035

21 - Pharmaceutical industry

Three subsectoral and three sectoral roadmaps are available for the pharmaceutical industry (Table 10). The scoring was based on the 2 subsectoral roadmaps, of which the majority contained formulated objectives. Half of the roadmaps contained an established plan, involved stakeholders and assessed employment and skills risks. The assessment of climate risks was absent in all the subsectoral roadmaps. Overall, this led to a scoring of 2.

Table 10: List of available roadmaps for the Pharmaceutical Industry subsector.

Subsectoral roadmaps	Sectoral roadmaps	General roadmaps
(ADB4) RAPPORT PUBLIC POUR LE SECTEUR DE LA CHIMIE ET DES SCIENCES DE LA VIE	Un écosystème industriel durable dans un monde qui évolue (Nouveau Position paper de l'UWE)	Green Skills Roadmap Flanders. Final Report on Green Skills Need in Flanders
Boost de transitie: kantel het industriebeleid mee in de juiste richting	Naar een koolstofcirculaire en CO2-arme Vlaamse industrie	TOEKOMSTBEELDEN -Vlaanderen circulair in 2050
TPEU - Chemical Industry	ERA industrial technology roadmap for circular technologies and business models in the textile, construction and energy-intensive industries	Plan de relance de la Wallonie Skills in transition - The way to 2035

22 - Manufacturing of rubber and plastic products

Three subsectoral and three sectoral roadmaps are available for this subsector (Table 11). The scoring was based on the 3 subsectoral roadmaps, that all contained formulated objectives. The majority of the roadmaps contained an established plan, involved stakeholders and assessed employment and skills risks. The assessment of climate risks was absent in all the subsectoral roadmaps. Overall, this led to a scoring of 2.

Table 11: List of available roadmaps for the Manufacturing of Rubber and Plastic Products subsector.

Subsectoral roadmaps	Sectoral roadmaps	General roadmaps
Skills roadmap voor de Vlaamse klimaattransitie. Focus op de energie-intensieve sectoren 2020-2035	Un écosystème industriel durable dans un monde qui évolue (Nouveau Position paper de l'UWE)	Green Skills Roadmap Flanders. Final Report on Green Skills Need in Flanders
Boost de transitie: kantel het industriebeleid mee in de juiste richting	Naar een koolstofcirculaire en CO2-arme Vlaamse industrie	TOEKOMSTBEELDEN -Vlaanderen circulair in 2050
TPEU - Chemical Industry	ERA industrial technology roadmap for circular technologies and business	Plan de relance de la Wallonie

models in the textile, construction and energy-intensive industries

Skills in transition - The way to 2035

43 - Specialised construction works

One subsectoral and two sectoral roadmaps are available for this subsector (Table 12). The scoring was based on the subsectoral roadmap, that contained formulated objectives, an established plan, involved stakeholders and assessed employment and skills risks. The assessment of climate risks was absent. Overall, this led to a scoring of 2.

Table 12: List of available roadmaps for the Specialised Construction Works subsector.

Subsectoral roadmaps	Sectoral roadmaps	General roadmaps
Heating systems installers Expanding and upskilling the workforce to deliver the energy transition	TPEU - Construction	Green Skills Roadmap Flanders. Final Report on Green Skills Need in Flanders
	ERA industrial technology roadmap for circular technologies and business models in the textile, construction and energy-intensive industries	TOEKOMSTBEELDEN -Vlaanderen circulair in 2050
		Plan de relance de la Wallonie
		Skills in transition - The way to 2035

19 - Coking and refining

Three subsectoral and three sectoral roadmaps are available for this subsector (Table 13). The scoring was based on the 3 subsectoral roadmaps, that all contained formulated objectives and an established plan. The majority of the roadmaps involved stakeholders and assessed employment and skills risks. The assessment of climate risks was absent in all the subsectoral roadmaps. Overall, this led to a scoring of 3.

Table 13: List of available roadmaps for the Coking and Refining subsector.

Subsectoral roadmaps	Sectoral roadmaps	General roadmaps
Skills roadmap voor de Vlaamse klimaattransitie. Focus op de energie-intensieve sectoren 2020-2035	Un écosystème industriel durable dans un monde qui évolue (Nouveau Position paper de l'UWE)	Green Skills Roadmap Flanders. Final Report on Green Skills Need in Flanders
Boost de transitie: kantel het industriebeleid mee in de juiste richting	Naar een koolstofcirculaire en CO2-arme Vlaamse industrie	TOEKOMSTBEELDEN -Vlaanderen circulair in 2050
TPEU - Chemical Industry	ERA industrial technology roadmap for circular technologies and business models in the textile, construction and energy-intensive industries	Plan de relance de la Wallonie
		Skills in transition - The way to 2035

29 - Construction and assembly of motor vehicles, trailers and semi-trailers

Three subsectoral and three sectoral roadmaps are available for this subsector (Table 14). The scoring was based on the 3 subsectoral roadmaps, that all contained formulated objectives and an established plan. The majority of the roadmaps involved stakeholders and assessed employment and skills risks. The assessment of climate risks was absent in all the subsectoral roadmaps. Overall, this led to a scoring of 3.

Table 14: List of available roadmaps for the Construction and Assembly of Motor Vehicles, Trailers and Semi-trailers subsector.

Subsectoral roadmaps	Sectoral roadmaps	General roadmaps
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AUTOMOTIVE SKILLS AGENDA - STRATEGY & ROADMAP	Un écosystème industriel durable dans un monde qui évolue (Nouveau Position paper de l'UWE)	Green Skills Roadmap Flanders. Final Report on Green Skills Need in Flanders
TPEU - Mobility Industrial Ecosystem	Naar een koolstofcirculaire en CO2-arme Vlaamse industrie	TOEKOMSTBEELDEN -Vlaanderen circulair in 2050
LOW CARBON ROADMAP PATHWAYS TO A CO2-NEUTRAL EUROPEAN STEEL INDUSTRY	ERA industrial technology roadmap for circular technologies and business models in the textile, construction and energy-intensive industries	Plan de relance de la Wallonie

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30 - Manufacturing of other transport equipment

One subsectoral and three sectoral roadmaps are available for this subsector (Table 15). The scoring was based on the one subsectoral roadmap, that contained formulated objectives, an established plan, involved stakeholders and assessed employment and skills risks. The assessment of climate risks was absent. Overall, this led to a scoring of 3.

Table 15: List of available roadmaps for the Manufacturing of Other Transport Equipment subsector.

Subsectoral roadmaps	Sectoral roadmaps	General roadmaps
TPEU - Mobility Industrial Ecosystem	Un écosystème industriel durable dans un monde qui évolue (Nouveau Position paper de l'UWE)	Green Skills Roadmap Flanders. Final Report on Green Skills Need in Flanders
	Naar een koolstofcirculaire en CO2-arme Vlaamse industrie	TOEKOMSTBEELDEN -Vlaanderen circulair in 2050
	ERA industrial technology roadmap for circular technologies and business models in the textile, construction and energy-intensive industries	Plan de relance de la Wallonie

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45 - Wholesale and retail trade and repair of motor vehicles and motorbikes

One sectoral roadmap and one subsectoral roadmap are available for this subsector (Table 16). The scoring was based on the subsectoral roadmap, that contained formulated objectives, an established plan, involved stakeholders and assessed employment and skills risks. The assessment of climate risks was absent. Overall, this led to a scoring of 3.

Table 16: List of available roadmaps for the Wholesale and Retail and Repair of Motor Vehicles and Motorbikes subsector.

Subsectoral roadmaps	Sectoral roadmaps	General roadmaps
AUTOMOTIVE SKILLS AGENDA - STRATEGY & ROADMAP	Comeos CSR rapport	Green Skills Roadmap Flanders. Final Report on Green Skills Need in Flanders
		TOEKOMSTBEELDEN -Vlaanderen circulair in 2050
		Plan de relance de la Wallonie

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10.3. Annex 3: Workshop participants

The list below indicates which organisations have been contacted to participate in the workshops. We would like to thank the participants for their cooperation.

Workshop Transport

- Participated: ABVV-BTB, ACV-Transcom, Canopea
- Cancelled: Febetra
- Contacted: ITS, Educam, D'Ieteren, Traxio

Workshop Health

- Participated: Prof. David Grimaldi, Unessa, FPS Health
- Contacted: FeBi, Vivo, Verso, ACV

Workshop agriculture and food industry

- Participated: Institute for the Future (KU Leuven), ILVO, Fevia, Boerenbond, EDUPlus
- Cancelled: ABVV-Horval
- Contacted: ACV Voeding en Diensten, Alimento, Flanders Food

Workshop R&D

- Participated: VLAIO; Innoviris, VARIO
- Cancelled: Belpo
- Contacted: Essencia, KU Leuven, Agoria, VB, NCP Wallonie, cfwb, ULB

Workshop circular economy

- Participated: ACV, Marion Courtois, Ecores, WSE Vlaanderen
- Cancelled: Repair&Share, Denuo
- Contacted: ABVV, HIVA KU Leuven, Vlaanderen Circulair

Workshop education

- Participated: Colruyt Group, Coren, cfwb, Duurzaam Educatiepunt Vlaanderen, The Shifters
- Contacted: VDAB