ChemSkills

Enabling the green and digital skills transformation of the chemical industry.

Report on ChemSkills Survey Results

1st iteration in Plastics

January 2025

Co-funded by the European Union

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1. Identification of Respondents

In total 40 responses, with 33 responses (82,50%) from the Industry & SMEs/industry associations.

Large	62,50%
Medium	20,00%
Small	12,50%
Micro	5,00%

The majority of responses were from Germany, Spain, the Netherlands, Belgium and Italy. It is important to mention that the questionnaire also covered a significant mapping outside the European context with a total incidence of responses of 5,52% from Serbia, the USA, China and numerous multinationals operating worldwide.

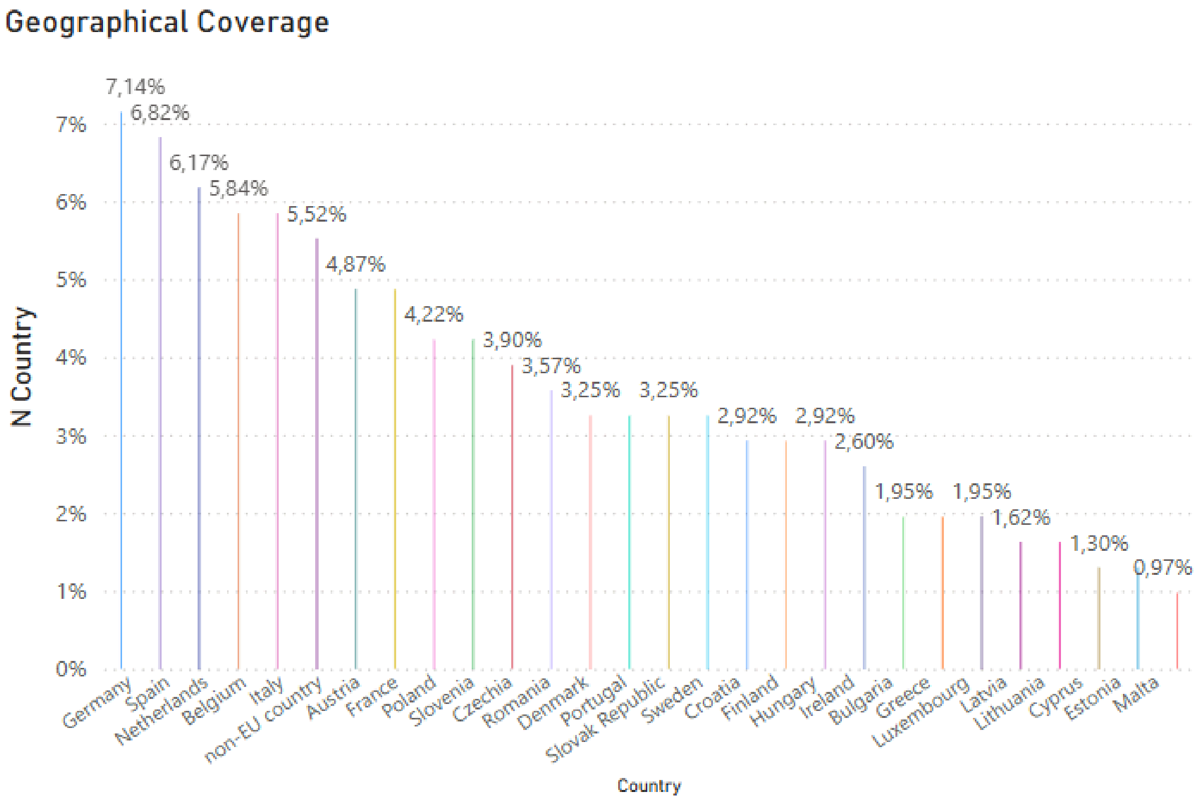

***Figure 1**: Geographical coverage of the survey.*

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2. Sectoral Needs to Meet Green & Digital Transition

Please interpret the current trends/drivers of change that you experience in your current market, how likely the sector is affected.

The data presented in Figure 2 highlights key trends driving change in the plastic sector, investigated for the green and digital transition. The most significant trend, accounting for 35.58% of responses, is the **growing emphasis on sustainability and the circular economy.** This reflects the increasing pressure on the industry to adapt by investing in innovative recycling technologies and sustainable production methods to align with the European and global environmental goals.

Regulatory changes impacting industry practices accounted for 27.88% of responses, underlining the increasing role of policies at the European and national levels in shaping the industry. Government attention to sustainability and carbon footprint reduction issues is pushing manufacturers to rethink their processes and materials and ensure compliance with these evolving regulations to remain competitive and avoid penalties.

The **increased adoption of digital technologies**, accounting for 25.96% of trends, signals the industry's shift towards automation, smart manufacturing and data-driven decision-making. Digital innovations, such as artificial intelligence-based waste sorting, blockchain for supply chain transparency and IoT-based tracking systems, are becoming key to optimising production and improving sustainability. It can be deduced, therefore, that industries in the sector are taking a greater approach to digital transformation to improve efficiency and minimise environmental impact and costs.

Furthermore, the **shift to automation and robotics**, which accounts for 8.65%, indicates an increasing reliance on technology to improve production processes, reduce waste and increase productivity. Automation plays a key role in modernising recycling plants, simplifying quality control and enhancing material recovery efforts. Although it represents a smaller percentage of trends, it supports the broader digital transformation needed for a sustainable future.

Finally, the **growing demand for personalised and customised products**, at 1.92%, suggests a minor but noteworthy shift in consumer expectations. Although sustainability remains a top priority, manufacturers may need to balance innovation in product design with environmental considerations.

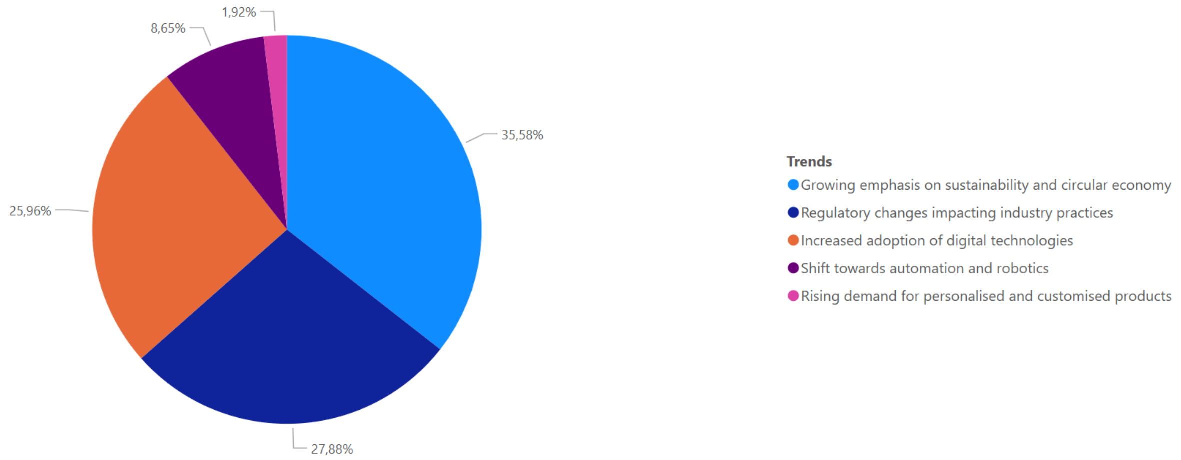

Figure 2: *Current trend and drivers of change in the plastic industry*

2.1. Sector competencies needed in Plastics

2.1.1. Sectoral

The survey results provide a clear picture of the sectoral competencies needed in the plastics industry, revealing the industry's priorities and potential gaps in expertise. The data suggests that safety, quality control, and material science are among the most critical areas, reflecting the industry's strong emphasis on regulatory compliance, risk management, and the technical understanding of polymer materials.

The highest-rated competencies include **Safety and Risk Management 82.6%**, **Safety Awareness 82.0%**, **Material Science 81.0%**, and **Quality Control and Assurance 80.6%**. These figures indicate that ensuring workplace safety and maintaining high product quality are fundamental requirements within the sector. The emphasis on material science highlights the industry's need for expertise in polymer chemistry, reinforcing the growing demand for knowledge in sustainable and high-performance plastic materials.

Following these core competencies, **Chemical Process Control and Monitoring 72.0%** and **Instrumentation Control and Monitoring 71.0%** hold significant relevance. Their

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importance suggests that process optimisation and automation play a crucial role in ensuring efficiency and sustainability in production. With increasing pressure to adopt greener manufacturing methods, having strong process control mechanisms is essential for reducing waste, energy consumption, and emissions.

Lower down the scale, competencies such as **Chemical Process Design 61.0%**, **Thermodynamics and Heat Transfer 59.6%**, **Reaction Engineering 55.0%**, and **Metallurgy 41.0%** are considered of a lower priority. The relatively lower ranking of chemical process design could indicate that existing production frameworks are well established, with less focus on fundamental redesigns. The reduced emphasis on metallurgy further supports the plastics industry's shift away from traditional metal applications towards more specialised polymer and composite materials.

Interestingly, the survey also identifies **Industrial Chemistry** as an additional relevant competency. This suggests that expertise in chemical formulations, surface treatments, and innovative material processing may become increasingly important, particularly as the sector explores sustainable alternatives such as bio-based plastics and advanced recycling technologies.

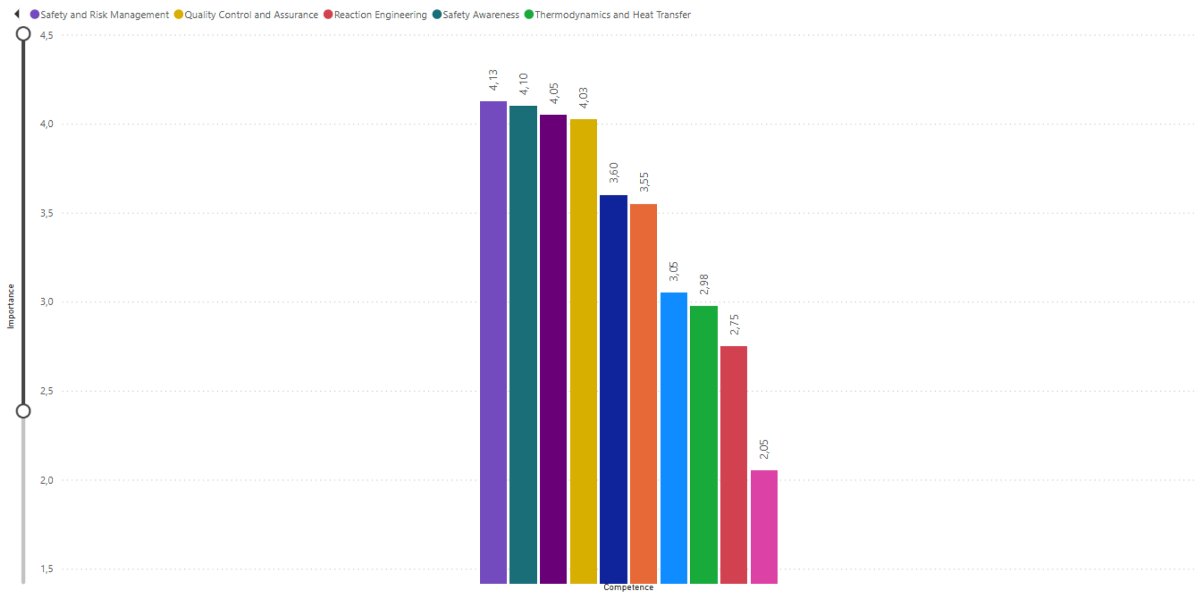

Figure 3: *Sectoral competencies needed in the Plastic industry.*

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2.1.2. Digital

The digital competency needs highlight a variety of technical skills that are essential for modern industry operations. **Sustainability and circular economy expertise**, which emerged as the most critical digital competency, received a high rating of 88,2%. This reflects the growing emphasis on integrating sustainable practices into digital processes.

Data analytics, rated at 82,6%, follows closely and underscores its importance in enabling informed decision-making through effective data interpretation. **Cybersecurity and network security**, with a notable rating of 78,0%, represents another significant area, driven by the need to safeguard digital infrastructures against growing threats.

Supply chain digitalisation and logistics, receiving a rating of 72,4%, highlight the ongoing shift toward optimising supply chains through digital tools.

Automation and robotics programming, rated at 66,8%, remains relevant as industries increasingly adopt automated solutions.

Digital twin modelling and simulation, with a moderate demand reflected by its rating of 63,8%, indicates its emerging role in replicating real-world processes virtually. **The Internet of Things (IoT)**, rated at 59,6%, and **3D printing and manufacturing**, which scored 50,2%, are seen as having more niche applications or lesser immediacy in the broader sectoral context.

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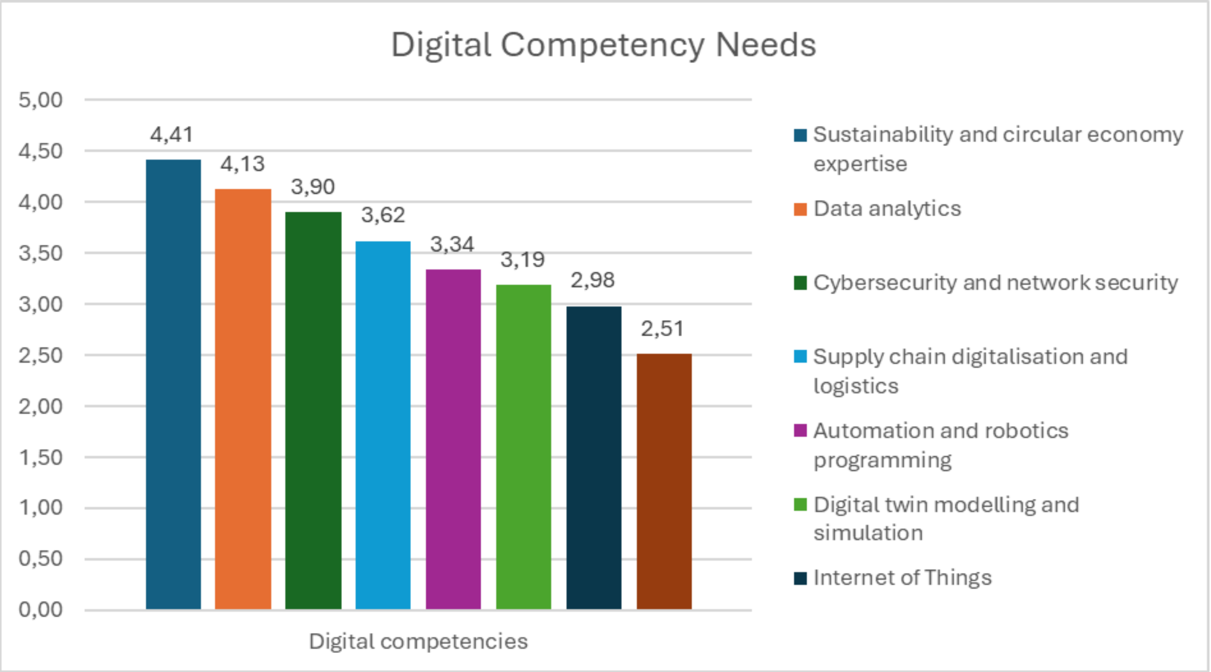

Figure 4: *Digital competencies needed in the Plastic industry*

2.1.3. Soft

Soft competencies, vital for collaboration and innovation, received uniformly high ratings, emphasising their critical role across all industries. **Problem solving**, the most essential need in this category, achieved the highest rating of 89,2%, underscoring its universal applicability in addressing complex challenges. **Communication** and **critical thinking**, both rated at 88,4%, share the second position, highlighting their equal importance in fostering clear exchanges of ideas and analytical approaches. **Safety and ethics**, with a strong rating of 81,8%, reflect the importance of ensuring ethical decision-making and adherence to safety standards. **Cognitive skills**, rated at 79,6% show the necessity of adaptable and flexible thinking in dynamic environments. **Social and emotional skills**, which scored 76,2 %, are valued for fostering teamwork and interpersonal relationships. **Content creation**, while still relevant, received a rating of 67,8%, placing it as less critical compared to other competencies in this category.

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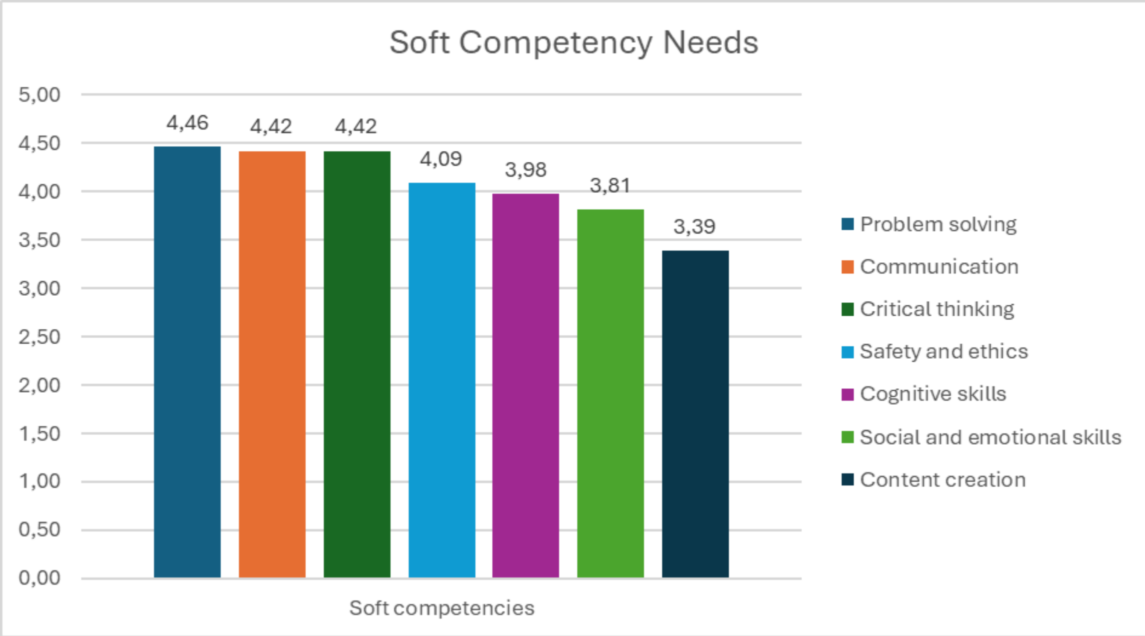

Figure 5: *Soft Skills needed in the Plastic industry*

2.1.4. Green

Green competencies are critical for advancing sustainability and environmental stewardship. **Embodying sustainability values** stands out as the top priority, receiving a rating of 84,2%, emphasising the need for professionals to integrate sustainability as a core principle. **Acting for sustainability** closely follows with a rating of 83,8%, highlighting the demand for proactive efforts to drive sustainable practices. **Energy efficiency focus**, rated 81,8%, reflects the importance of minimising energy consumption across operations. **Monitoring and predicting environmental impact**, which received a rating of 81,0%, showcases the value of tools and expertise for assessing ecological consequences. **Envisioning sustainable futures**, rated at 80,2%, completes the list, stressing the importance of strategic foresight in achieving long-term environmental goals.

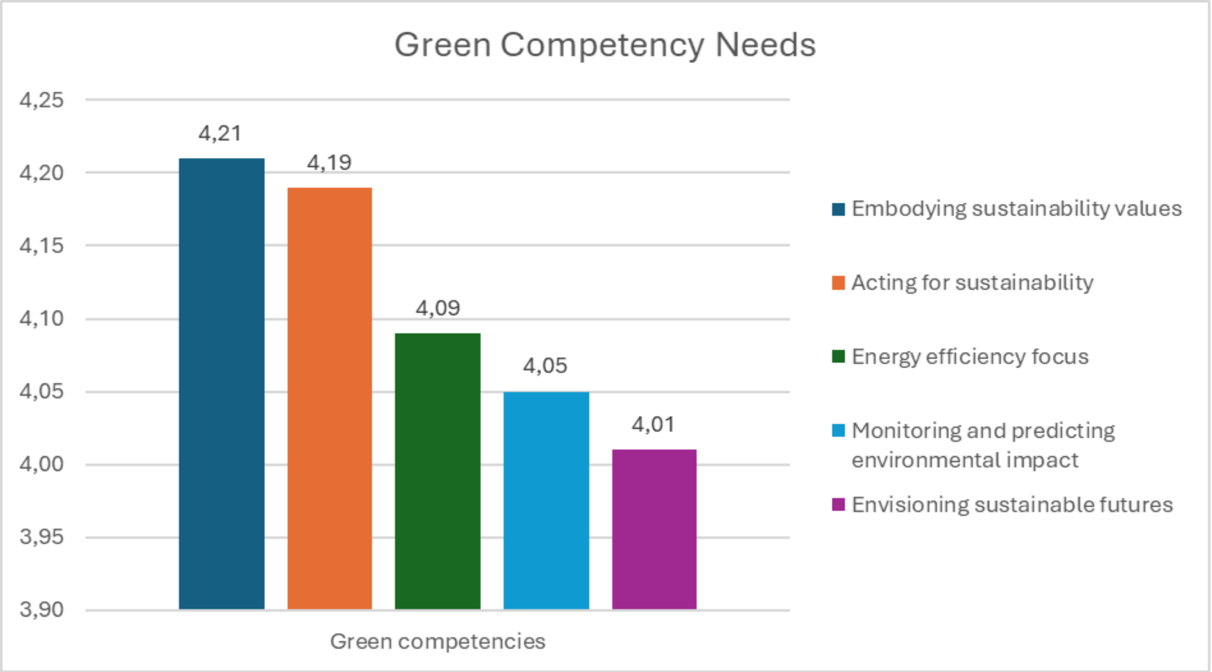

***Figure 6**: Green competencies needed in the Plastics industry*

2.2. Workforce needed in Plastics

The immediate (1–2 years) challenges for the plastic industry highlight the **availability of a workforce with adequate skill sets** as the most pressing issue, receiving the highest importance rating at 85%. This underscores a significant gap in skilled labour, which could hinder productivity and innovation in the short term. The **integration issues with existing systems** follow with a rating of 72%, indicating that technological compatibility and operational efficiency remain substantial concerns.

The **availability of training programs for reskilling and upskilling** is also a notable challenge, rated at 70.6%. This suggests that existing workforce training opportunities may not be sufficient to meet evolving industry demands. Lastly, **initial investment costs** received a rating of 69%, signifying that financial barriers also play a role in limiting the sector's ability to address workforce development needs effectively.

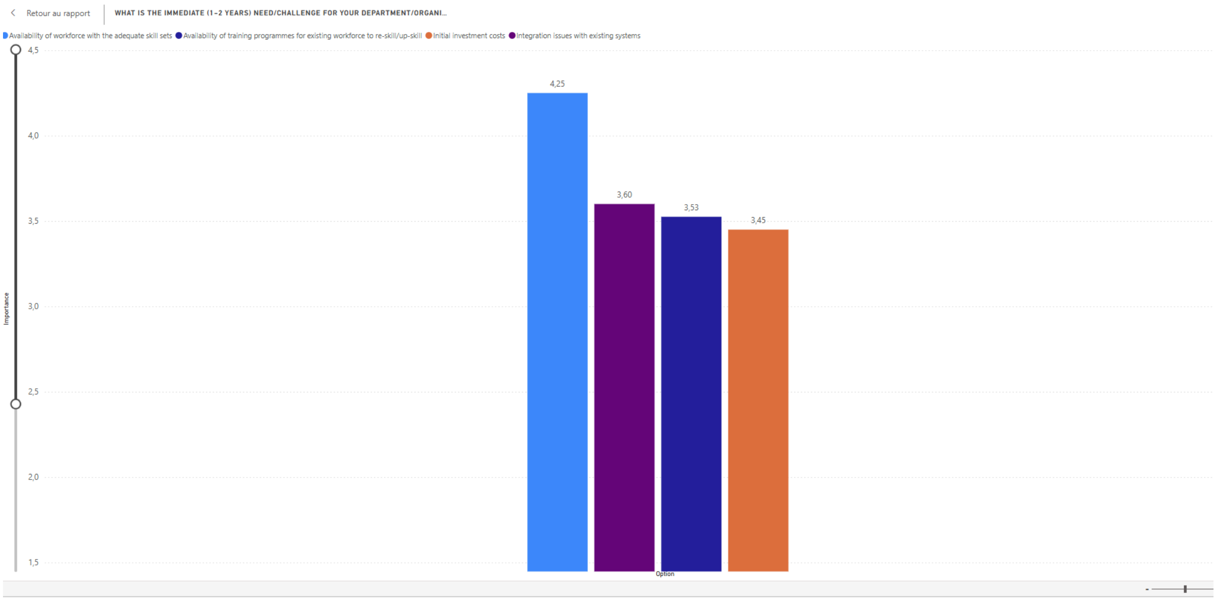

***Figure** 7: Short-term needs and challenges in the plastic industry.*

For long-term needs (5–10 years), the **availability of a workforce with the right skill set** remains the dominant concern, with an increased rating of 86.6%. This suggests that the issue of skilled labour shortages is expected to persist unless proactive measures are taken. The **availability of training programs** scores 72.6%, reflecting a continuous need for structured learning and upskilling initiatives. The significance of **initial investment costs** 69% and **integration issues with existing systems** 68% remains consistent, indicating ongoing financial and operational concerns.

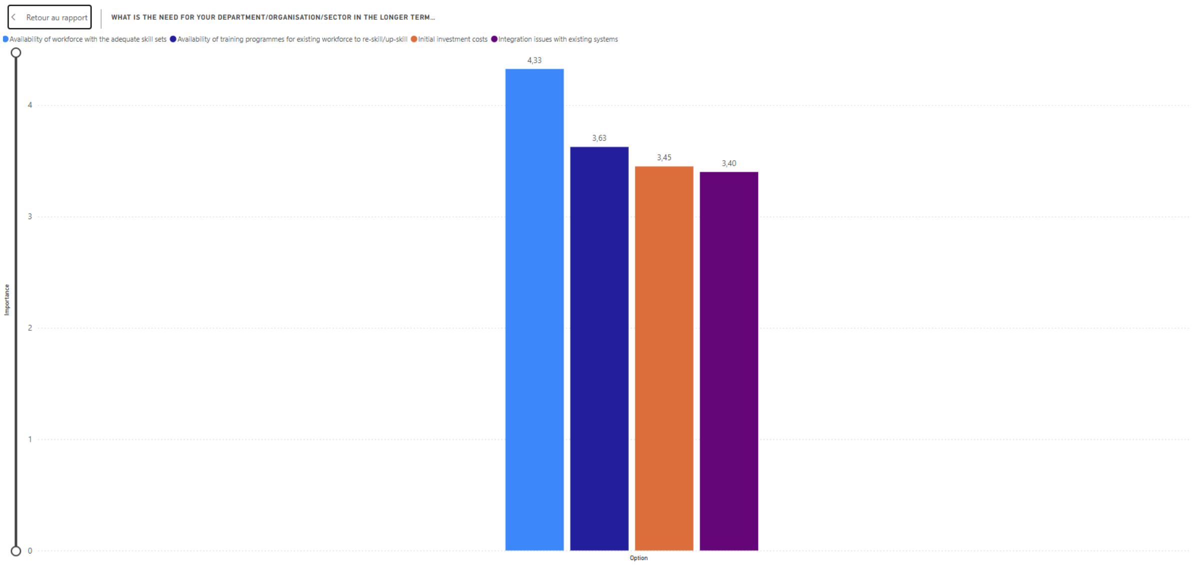

***Figure 8**: Long-term needs and challenges in the plastic industry.*

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The workforce distribution in the plastic industry for the short term, highlights the varying degrees of necessity for different roles**. Professionals make up the largest share at 17.34%**, indicating the industry's strong reliance on expertise, research, and problem-solving capabilities. **Technicians follow closely at 16.14%,** reflecting their essential role in maintaining and improving production processes. **Workers and operators account for 14.98% and 14.76%**, respectively, emphasising their significance in day-to-day manufacturing activities. **Managers represent 14.42%**, suggesting a notable focus on leadership and operational oversight. The **elementary workforce, at 12.05%, and assemblers, at 10.33%**, constitute the smallest portions, hinting at either a shift toward automation or a decreased reliance on manual, repetitive labour.

The fact that **professionals and technicians together comprise over 33%** of the workforce indicates a growing need for specialised skills, likely driven by increasing technological advancements in the industry. Meanwhile, the comparatively lower percentage of assemblers and elementary workforce roles suggests that automation and process optimisation may be reducing the demand for purely manual labour. This trend raises important considerations for workforce development, particularly in terms of training and skill-building initiatives.

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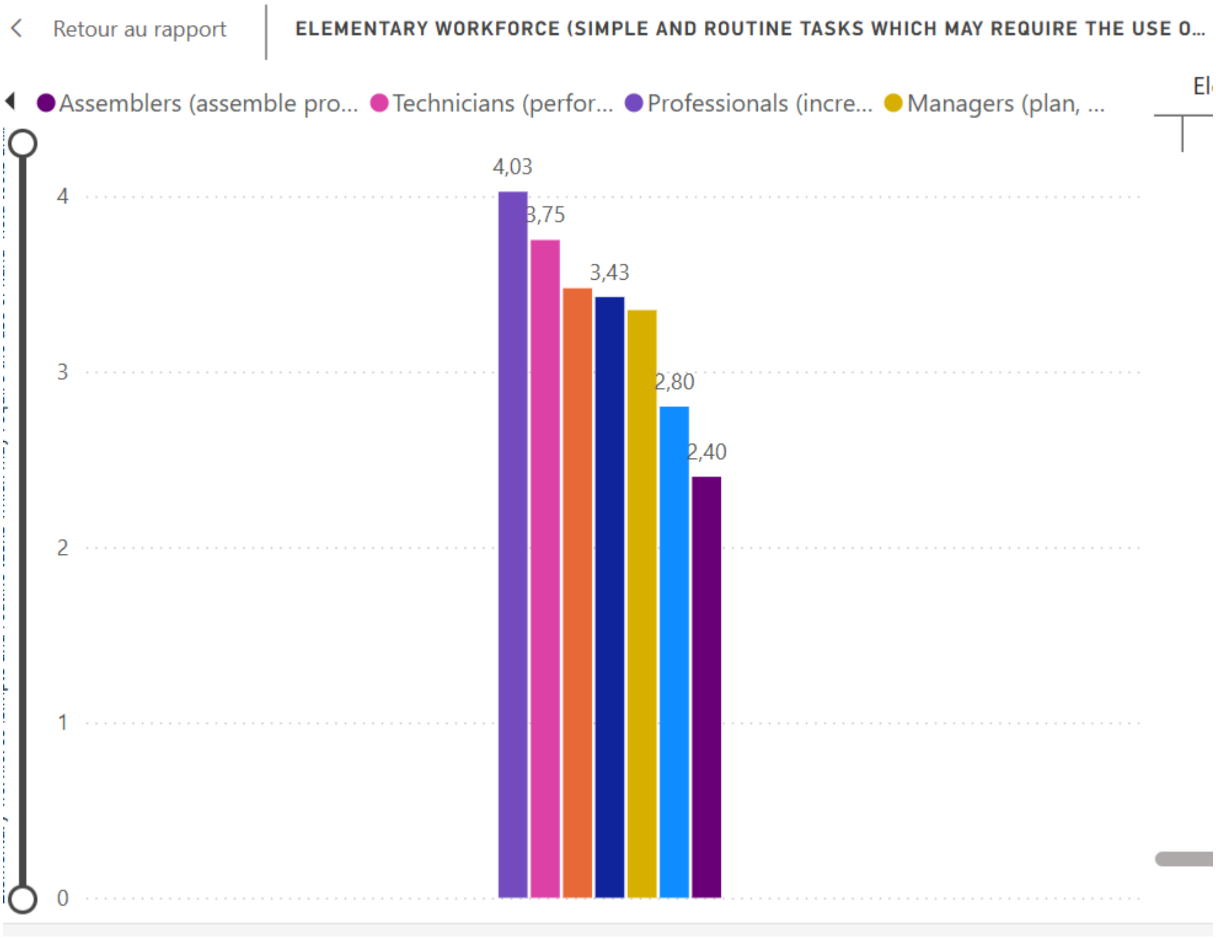

***Figure 9**: Elementary workforce needed in the plastic industry in the short term.*

The long-term workforce distribution in the plastic industry highlights the continued demand for skilled labour. **Professionals make up the largest share at 17.45%**, reinforcing their crucial role in innovation and problem-solving. **Technicians follow at 15.73%**, showing a slight decrease compared to the short term. **Workers and operators each represent 14.96%**, maintaining their steady presence in production. **Managers account for 14.32%**, reflecting a consistent need for leadership. **The elementary workforce makes up 11.76%**, showing a slight decline from 12.05% in the short term, while **assemblers increase to 10.82% from 10.33%.**

Compared to the short-term outlook, professionals see a minor increase, showing a growing reliance on expertise. Technicians experience a slight decline, possibly due to automation or efficiency improvements. Workers and operators remain stable, emphasising their sustained importance in manufacturing. The elementary workforce continues to shrink, aligning with automation trends that reduce the need for routine manual labour. In contrast, the increase in assemblers suggests a potential shift toward specialised assembly tasks that require precision.

These trends indicate that the plastic industry will continue prioritising skilled professionals and technicians while maintaining stable levels of workers and operators. The gradual decline of the elementary workforce suggests a long-term shift toward automation, while the rise in assemblers may reflect a growing need for specialised manual tasks.

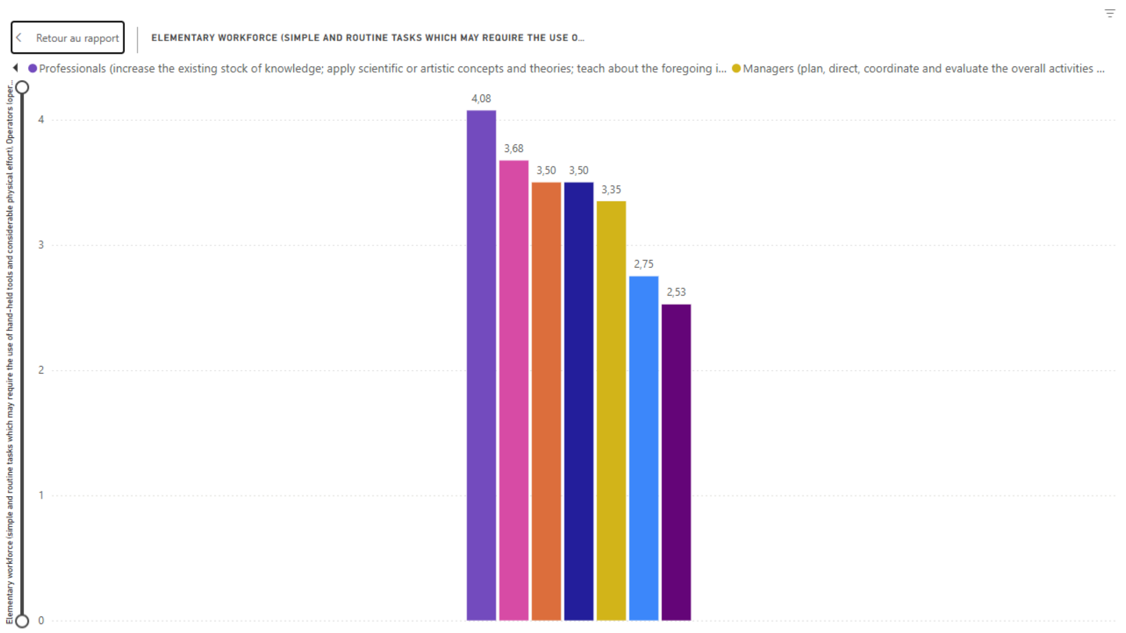

Figure 10: *Elementary workforce needed in the plastic industry in the long term.*

2.3. Training Need in the Transition in Plastics

A little more than 50% of the survey respondents claimed that sector-specific training is in place or will be implemented in the future. The remaining numbers reported that no training is or will be in place in the plastic sector, which could be due to targeted-hiring or low-skilled job openings which do not require training.

Amongst the numbers, around 27.3% of training targets business model and sustainability, 23% targets digital tools and AI, 18% targets technical training, and 19% targets company systems, software and cybersecurity while the rest are unspecified (**Figure 11**). This data

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indicates an increased emphasis on closing the gap between IR4 digitalisation and plastics processing, which is often hands-on mechanical work. Sustainability is an important topic in the plastic industry, as this polymer, among others, is often associated with man-made pollution. Sustainability-themed training is especially necessary for the upper levels and policymakers to tailor a circular operation within the plastic industry. Additionally, many companies also offer training in digital tools and AI which is especially useful in the production line for quality monitoring, plastic characterisation, and sorting. An increased number of state-of-the-art technologies have been introduced to the plastic sector, such as hyperspectral imaging coupled with AI image recognition [1], [2] and *in situ* plastic characterisations [3], [4]. However, integrating these new systems into existing operations requires a major process line alteration and sometimes, changes in company systems.

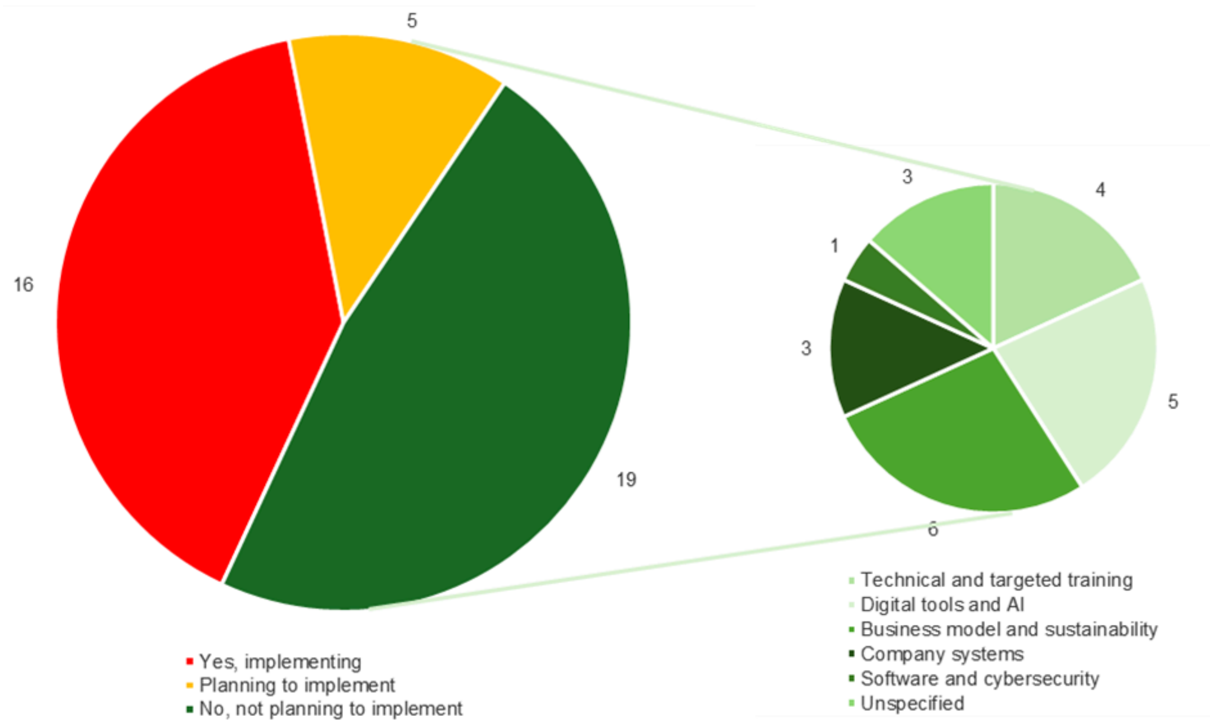

Figure 11: *shows the consensus of a company on training provision in the plastics sector. The pie chart is further broken down into the categories of training that is implemented (if any).*

In **Figure 12**, almost 30% of the respondents claimed that they were unaware of any available education linked to the plastics sector in their respective EU countries. However, this is not an accurate representation of the actual number of educations offered but is likely due to the unfamiliarity of the respondent to the sectoral offer market. On the other hand, 36% and 29%

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of responses reported the existence of undergraduate and postgraduate courses or training which are specific (or related) to the plastics sector. Remarkably, half of the undergraduate numbers represent courses related to automation and robotics, which is synonymous with the increased implementation of automation in the processing industry. For example, TU Delft is often named as one of the institutions providing automation and AI-related courses. In their undergraduate course ‘Sustainable Packaging in a Circular Economy’, students learn to improve the design of packaging systems using sustainable materials, as well as efficient processing systems. Real-life case studies are also introduced to improve the subjects’ practicality. Moreover, half of the postgraduate education consists of engineering-related courses. To obtain the EUR ING Certificate accredited by Engineers Europe, an educational level of EQF 7 accompanied by 2—5 years of working experience (available for exchange with post-education years) is expected [5]. Comparably, fewer postgraduate courses for operators and technicians (which only require an EQF 1—5) are known to exist. Among the organisations offering plastic-processing training that are named include Polymer Science Park, PlasticEurope, Das Kunststoff-Zentrum (SKZ) and VDI Wissensforum

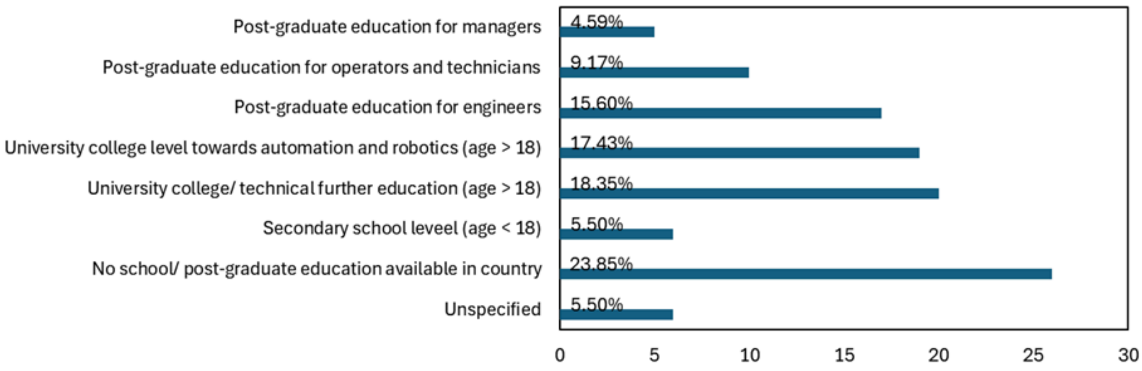

Figure 12: *The educational availability in the plastics sector.*

3. Generation and Gender Gaps

From the response in **Figure 13**, there is a major difference in the presence of a generation and gender gap in the plastics sector. While almost 70% of responses show that no gender gaps exist, an overwhelming 90% of responses claim that there is a generation gap. Again, the digitalisation and automation of the plastic industry call for additional training or hiring of the younger generation who have undergone these updated pieces of training. It is hypothesised that the ‘older’ generation who had been working in the industry for many years is now in a

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more senior or managerial position. In these positions, training may not be deemed necessary and might even be time-consuming. No examples have been given to explain the point, therefore posing a potential for investigation in the next iteration.

In terms of gender gaps, most who had responded ‘yes’ explained that significant gaps are present in STEM, especially in information technology, AI and digitalisation. However, there is no elaboration on the ratio of men to women when it comes to the scope of operators, engineers, managers, technicians and researchers. The plastics industry often requires polymer and chemical engineers, which are one of the engineering sectors that consist of high numbers of women

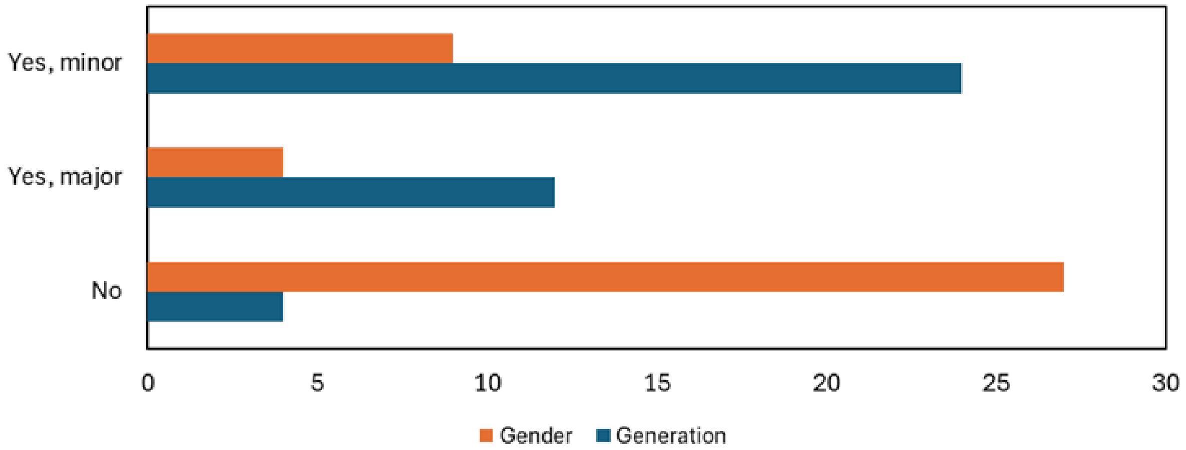

Figure 13 *shows the survey’s response to generation and gender gaps within the plastics sector.*

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