

Spotlight on talents in the German battery industry

How companies can secure their demand by promoting diversity.

Publication of the Accompanying Research for the funding programme for Battery Cell Production on behalf of the German Federal Ministry for Economic Affairs and Climate Action



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CONTENTS

Executive Summary	3
1 Introduction	5
Objective and structure of the study	5
2 Why diversity pays off: A key to overcoming the shortage of skilled talents and gaining lasting competitive advantages	7
3 Diversity in battery cell manufacturing – status quo in Germany	9
3.1 Insights into skilled workers by gender, nationality and age	10
3.1.1 Results regarding the status quo	11
3.1.2 Methodology and approach for the analysis of employment statistics of the German Federal Employment Agency	22
3.2 Demand for versus shortage of skilled workers – insights into the demand for skilled workers over the next ten years	26
3.2.1 The demand for skilled talents	27
3.2.2 Methodology and approach for modelling the demand for skilled workers	31
3.3 Insights into diversity and diversity measures of battery cell manufacturing companies in Germany	36
3.3.1 Survey results for diversity and diversity measures in companies	37
3.3.2 Online survey methodology and approach	40
4 Promotion of diversity in battery cell manufacturing – recommendations	42
4.1 Diverse managers with diversity-oriented competencies	46
4.2 A company culture that values diversity	47
4.2.2 Evaluation of measures and their effects – spreading the word about diversity	53
4.3 Diversity focus in personnel recruitment and retention	56
4.3.2 Recruiting skilled talents from abroad	59
4.3.3 Occupational career paths	59
5 Conclusion	61
References	63
Table of figures	67
List of tables	70
List of abbreviations	71



EXECUTIVE SUMMARY

The demand for skilled workers in the battery industry will increase steadily over the next ten years. This will result in the creation of tens of thousands of jobs in battery production in Europe alone. Between 1,000 and 5,000 additional skilled workers will be needed annually until 2033, just in production. The industry is then expected to consolidate and employment figures should reach a plateau. Consolidation will likely lead to companies with higher product quality and process yield standards to assert themselves against competitors, while others will fall short. In order to meet those standards and persist in a competitive market, companies need qualified skilled talents who are able to understand and manage complex production processes.

If the battery industry wants to fully tap into the potential of skilled workers in the labour market, it needs to place greater emphasis on diversity and offer equal opportunities for all employee groups. The competition for specialists with experience in battery production has become global. This study examines the labour market in Germany's battery ecosystem from various points of view, with a special focus on diversity. Companies that succeed in attracting and retaining skilled talents through a diversity-friendly company culture will have an advantage in competing for skilled workers. This study evaluates current figures, models the needs of various occupational groups and explores the potential of diversity, based on the state of research. Those evaluations and analyses lead to recommendations aimed at supporting companies in the battery ecosystem to comprehensively analyse their own situation and foster development strategies. The study intends to demonstrate what companies can do to become an attractive employer in the global labour market. This is becoming increasingly important as the shortage of skilled workers is prominent.

According to data from the German Federal Employment Agency, the battery production sector has a lower proportion of women at 24% compared to the labour market as a whole, but a higher proportion of women compared to STEM occupations in general. Battery cell manufacturing may offer more attractive work conditions for women compared to other STEM occupations. The proportion of foreign nationals at 16% is about the same as their proportion in the labour market as a whole. It appears that this industry has offered special incentives for foreign nationals in recent years. They account for 73% of the increase in personnel between 2020 and 2021. A modelling for this study shows that the proportion of women and foreign nationals based on individual occupational groups is higher in this industrial

sector than it could be expected based on the proportion in the respective skilled occupations (training and university courses). Among the skilled workers that are in demand, skilled occupations of a technical nature (especially mechanics) and in natural sciences (especially materials/chemistry) are particularly sought after. However, with a significant gender pay gap of 18% and falling representation of women and foreign nationals in leadership positions, their sustainable integration in this sector faces challenges similar to those found in the labour market as a whole.

The analysis of data collected in an online survey for this study shows that when company management has committed to promoting diversity, the proportion of women and the age diversity are higher in their workforce. Around 40% of the surveyed companies have already made such commitments, establishing an essential basis for their company's attractiveness and the lasting employment of skilled talents. This study provides concrete measures and recommendations to support these efforts. Three aspects are of special importance to realise positive effects through diversity: *Raising awareness, accountability and repetition*. Thus, to achieve these effects it is important to teach diversity-oriented competencies in management development, establish diversity in the company culture, promote diversity by company management and at all management levels, and integrate diversity into processes with accountability. Increasing accountability for measures can help ensure that they are in fact implemented, notwithstanding a possibly more traditional company culture. This leads to positive experiences so that company cultures can (gradually) change. Participative processes should be consistently repeated, leading to the acceptance of diversity and alternative lifestyles over the long term. Thus the labour market becomes more globalised, interdisciplinary and inclusive.

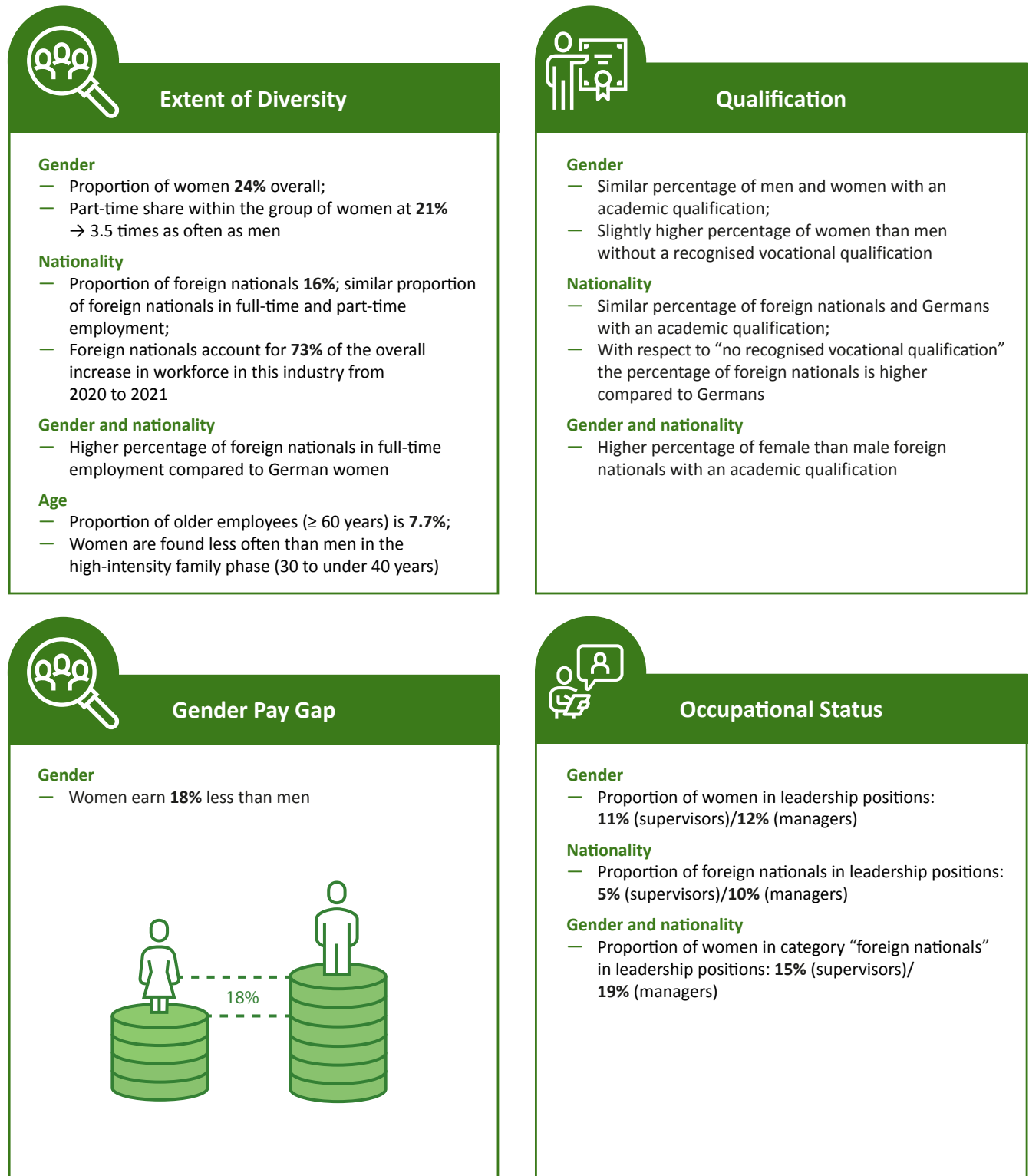


Figure 1: Status quo on diversity in the sector “Manufacture of batteries and accumulators” in 2021; source: Special statistical analysis of the German Federal Employment Agency; in-house representation.

1 INTRODUCTION

The phase out of the manufacturing and usage of internal combustion engines is bringing about radical change in the automobile industry. This transformation affects the entire sector profoundly, creating a greater need for skilled workers¹ with new qualifications going forward in order to meet the increasing demand for electrochemical storage capacity and electric vehicles. Demographic change, the hurdles of digitalisation and decarbonisation as well as global developments such as the COVID-19 pandemic and the war in Ukraine are making the transformation more difficult. Thus the battery industry, like many others, is facing the challenge of securing skilled talents. Companies have to adopt new strategies and solutions to recruit skilled talents and retain them over the long term. Diversity is becoming increasingly important in this context. Establishing a broadly diversified workforce in the automobile industry is crucial in order to rise to these challenges. Diversity opens up new perspectives, offers innovative solutions and makes it easier to adapt to changing conditions quickly. By establishing a diverse workforce, the industry can overcome the challenges of its transformation and fully utilise the opportunities arising from it.

In light of the global challenges posed by climate change, energy storage plays a key role in the electromobility context. Global demand is increasing tremendously due to the need in electromobility, as stationary storage and in other industrial and private applications. This demand is currently being met mainly by battery production capacities in Asia, however North America and Europe will increasingly contribute in the future with expanding production capacities. European production capacities are expected to grow to 20-30% of global production (Thielmann et al. 2021²). Currently the European battery production capacity predicted for 2030 is around 1,300 GWh/a (Heimes 2022³).

Numerous factories are being built to reach these capacities, creating thousands of new jobs. The new occupational

profiles in battery cell manufacturing⁴ do however require different competencies. Already today there are shortages in certain technical occupations. These become significant in view of battery cell production demands, especially in the natural sciences and technical fields (Bundesregierung 2022⁵). A diverse workforce with various competencies and perspectives can help with surmounting these challenges. To accomplish this, companies need to take systematic steps to promote an inclusive culture and establish a diverse workforce. For example, concerted recruiting efforts and training can make employees more aware of the importance of diversity. Work conditions also need to be established that enable all employees to realise their full potential and to thrive free of discrimination.

To sum up, integrating diversity into the workforce is an opportunity for companies in the automobile industry to surmount the transformation of the sector while finding innovative ways to strengthen their position in a rapidly changing market.

Objective and structure of the study

The objective of the study is to identify how the future demand for skilled workers within the battery value chain in Germany can be met through the promotion of diversity in companies, provided that necessary general conditions are established. The strategy of the German federal government for skilled workers emphasises the equality of women and men in the labour market and the improved integration of skilled talents from abroad to meet the corresponding demand in Germany, as well as the significance of companies as important key players⁶, to drive a corresponding culture change through strategic HR management (Bundesregierung 2022⁷).

1 The word “workers” and “talents” are used simultaneously.

2 Thielmann, Axel; Neef, Christoph; Hettesheimer, Tim; Ahlbrecht, Katharina; Ebert, Sandra (2021): Future Expert Needs in the Battery Sector. Published by EIT RawMaterials GmbH. Berlin. Available at: <https://eitrawmaterials.eu/wp-content/uploads/2021/03/EIT-RawMaterials-Fraunhofer-Report-Battery-Expert-Needs-March-2021.pdf>, accessed: 14.10.2022.

3 Heimes, Heiner (Publisher) (2022): Battery Atlas 2022. Shaping the European Lithium-Ion Battery Industry, 1st edition. Aachen: (PEM) | RWTH Aachen University.

4 The terms “battery cell manufacturing” and “battery cell production” are used simultaneously.

5 Federal Government (2022): Fachkräftestrategie der Bundesregierung. Published by Federal Ministry of Labour and Social Affairs. Berlin. Available at: https://www.bmas.de/SharedDocs/Downloads/DE/Publikationen/fachkraeftestrategie-der-bundesregierung.pdf?__blob=publicationFile&v=5, accessed: 17.10.2022.

6 Along with employees, states and municipalities, social partners, trade and professional associations, the German Federal Employment Agency, (continuing) educational institutions and the German federal government

7 Federal Government (2022): Fachkräftestrategie der Bundesregierung. Published by Federal Ministry of Labour and Social Affairs. Berlin. Available at: https://www.bmas.de/SharedDocs/Downloads/DE/Publikationen/fachkraeftestrategie-der-bundesregierung.pdf?__blob=publicationFile&v=5, accessed: 17.10.2022.

Definition of diversity

In the labour market, this refers to the variety and individuality of the workforce, based on different aspirations, lifestyles and individual, differing personality traits⁸.

This study provides decision makers in companies with compelling qualitative and quantitative arguments for why promoting diversity is not only wise but necessary to overcome the shortage of skilled talents in the battery industry. The study is intended for the management level and the HR departments of companies operating in the German battery ecosystem, who are facing challenges related to find and secure skilled workers and qualifications. The study presents the current state of diversity for battery cell manufacturing in Germany (status quo), which establishes a basis for assessing potential areas for improvement. It provides recommendations and identifies concrete measures for promoting diversity in companies to realise the outlined potential.

It also describes the general conditions that have to be established for diversity to lead to long-term success. The empirical and theory-based sections of the study are aligned to varying degrees with the diversity dimensions of “gender”, “nationality” and “age diversity”, thereby providing insights from different perspectives. However, the study acknowledges that other diversity dimensions should be examined in subsequent research studies.

The study achieves its objective by conducting quantitative analyses of the current situation and formulating recommendations based on the theoretical and empirical literature on the topic of diversity management. Sections 1 and 2 provide an introduction to the study, a definition of the key terminology and a description of general requirements for conditions and resulting benefits of promoting diversity in the battery industry. Subsequently the study is structured as follows:

Diversity in battery cell manufacturing Status quo in Germany

- Inventory
- Demand for talents
- Diversity in companies



Promotion of diversity in battery cell manufacturing

- Recommendations
- General conditions
- Measures



2 WHY DIVERSITY PAYS OFF: A KEY TO OVERCOMING THE SHORTAGE OF SKILLED TALENTS AND GAINING LASTING COMPETITIVE ADVANTAGES

Key findings

Diversity, meaning the variety and individuality of the workforce, helps companies position themselves as attractive employers in the labour market. The numerous possibilities of learning from each other harbour the potential of a diverse workforce responding with greater flexibility to new challenges and changes in the working environment. Studies prove that diversity is a success factor and innovation driver for companies. It is therefore a suitable tool to address the shortage of skilled workers. However, this does not happen automatically and requires diversity competencies both in employees and at management level to appropriately approach diversity as such and possibly arising conflicts. It is therefore important to value and promote diversity through diversity management, for example, by means of strategic human resource management.

Grappling for qualified skilled talents

The ramp-up of battery cell manufacturing in Germany is creating numerous new jobs, but many companies are struggling to fill them. The shortage of qualified skilled workers is a major issue. As the market scales up, skilled workers with knowledge of innovative technologies are needed for the development of batteries and for the anticipated growth of production capacities. National and European qualification initiatives⁹ for the continuing education and training of staff and skilled workers from related sectors, such as the automobile industry, are still in their infancy and they are not yet ready to make a major contribution towards alleviating the shortage of skilled talents. Furthermore, qualified skilled workers are often recruited by competitors, intensifying the competition for them. Demographic change will also drive demand. These interrelated circumstances could have severe consequences for the industry's competitiveness and may delay the ramp-up. Effective measures are necessary to recruit and retain skilled talents to counteract this. Diversity (management) can play a central role in addressing the shortage of skilled talents.

Qualification requires initiative

The EBA Academy cites around 800,000 employees in Europe who require training, continuing education or retraining by 2025¹⁰. This magnitude makes it clear that qualification efforts cannot succeed without the support of companies. Qualification initiatives such as the EBA Academy, ALBATTs and the German Battery Competence Trios were therefore launched.

Promoting diversity as a solution to ensure the supply of skilled workers

The objective of diversity management is to value and promote diversity, meaning the variety and individuality of the workforce based on different aspirations, lifestyles and differing individual personality traits (Charta der Vielfalt e.V. 2022¹¹; Dreas and Rastetter 2016¹²). It is a corporate governance strategy and (also) a resource-oriented approach to promoting diversity, aimed at putting diversity to productive use and consequently gaining a competitive

9 <https://www.eba250.com/actions-projects/other-initiatives/> [Accessed on 24.03.2023]

10 <https://www.eba250.com/eba-academy/about-eba-academy/> [Accessed on 24.03.2023]

11 Charta der Vielfalt e.V. (2022): Factbook Diversity. Published by Charta der Vielfalt e.V. Berlin. Available at: https://www.charta-der-vielfalt.de/fileadmin/user_upload/Diversity-Tag/2022/Deutscher_Diversity-Tag_2022/Factbook_2022.pdf, accessed: 15.08.2022.

12 Dreas, Susanne; Rastetter, Daniela (2016): Die Entwicklung von Diversity Kompetenz als Veränderungsprozess. In: Genkova, Petia und Tobias Ringeisen (Publisher): Handbuch Diversity Kompetenz. Wiesbaden: Springer, S. 351–369.



Figure 2: Dimensions of diversity based on Gardenswartz and Rowe (Diverse Teams at Work (2nd Edition, SHRM, 2003)); in-house representation.

advantage (Dreas and Rastetter 2016¹³). Diversity can thus be a success factor for companies. It is comprised of various diversity dimensions (see Figure 2). In the following sections, three of the internal dimensions are examined in greater detail: gender, nationality and age.

The numerous possibilities of learning from each other frequently allow a diverse workforce to respond with greater flexibility to new challenges and changes in the working environment. In a study, 72% of small to midsize enterprises surveyed reported that diversity had a positive impact on employee productivity. Additionally, 68% reported improved employee satisfaction and 65% reported greater innovativeness (Welter et al. 2015¹⁴).

While having a diverse workforce can yield many benefits, these benefits are not automatic. It is essential for both employees and especially management to have corresponding diversity competence in order to harvest the benefits.

Diversity competence refers the development of specific skills to manage diversity and to resolve conflicts that may arise from it. Additionally, it involves having a mindset that is in favour of diversity, its promotion and productive use within the company. Teaching diversity competence for the successful implementation of diversity management aims to change the company culture in the long run (Dreas and Rastetter 2016¹⁵). It can be accomplished in particular through seminars, workshops and training programmes.

Diversity management holds great potential, especially in addressing the shortage of skilled talents in Germany (Charta der Vielfalt e.V. 2022¹⁶). Thus, diversity management can be a key factor in addressing the shortage of skilled workers and in becoming more resilient in competing for skilled workers.

13 Dreas, Susanne; Rastetter, Daniela (2016): Die Entwicklung von Diversity Kompetenz als Veränderungsprozess. In: Genkova, Petia und Tobias Ringelsen (Publisher): Handbuch Diversity Kompetenz. Wiesbaden: Springer, S. 351–369.

14 Welter, Friederike; Bijedic, Teita; Hoffmann, Marina (2015): Triebwerk des Erfolgs – der deutsche Mittelstand im Fokus. Published by Institut für Mittelstandsforschung. Bonn. Available at: https://www.researchgate.net/profile/Teita-Bijedic/publication/284726209_Triebwerk_des_Erfolgs_-_der_deutsche_Mittelstand_im_Fokus/links/56582af508aeafc2aac236fc/Triebwerk-des-Erfolgs-der-deutsche-Mittelstand-im-Fokus.pdf?origin=publication_detail, accessed: 15.08.2022.

15 Dreas, Susanne; Rastetter, Daniela (2016): Die Entwicklung von Diversity Kompetenz als Veränderungsprozess. In: Genkova, Petia und Tobias Ringelsen (Publisher): Handbuch Diversity Kompetenz. Wiesbaden: Springer, S. 351–369.

16 Charta der Vielfalt e.V. (2022): Factbook Diversity. Published by Charta der Vielfalt e.V. Berlin. Available at: https://www.charta-der-vielfalt.de/fileadmin/user_upload/Diversity-Tag/2022/Deutscher_Diversity-Tag_2022/Factbook_2022.pdf, accessed: 15.08.2022.

3 DIVERSITY IN BATTERY CELL MANUFACTURING – STATUS QUO IN GERMANY

To profit from the investments in battery cell manufacturing in Germany, companies need to hire numerous qualified skilled talents and to retain employees over the long term. Strengthening the company's own diversity helps satisfy the demand, if the general conditions are met (see Section 4). The following subsections 3.1 – 3.3 provide an overview of the status quo in Germany.



3.1

Figures on the extent of diversity in battery cell manufacturing in Germany



3.2

Analysis of the demand for skilled workers, focusing on production staff



3.3

Diversity measures/management in companies: spread and effects



3.1 Insights into skilled workers by gender, nationality and age

Key findings

The 18% gender pay gap (as of 2021) and the lower proportion of women in companies (especially among full-time employees) and in leadership positions reveal clear deficits in the industry's personnel structure. These are presented for the sector "Manufacture of batteries and accumulators". A key aspect for companies in competing for skilled workers is to make the sector more attractive for women, also regarding earnings and opportunities for advancement, and to promote good work conditions in leadership positions (such as career and family balance). However, the proportion of women in this sector is somewhat higher compared to the STEM industries in general. Battery cell production may offer better opportunities for women than other STEM industries, for instance regarding the possibility of working part time. The integration of older workers and women in the high-intensity family phase from 30 to 40 years of age poses additional challenges in battery cell manufacturing.

The proportion of foreign nationals in the examined economic activity at 16% is approximately equal to that of the German labour market as a whole. A significant increase of 35% was observed for 2021 in the group of academics among women who are foreign nationals. These figures may indicate that foreign recruitment measures are taking effect.

The (few) women among the foreign nationals are also comparatively well positioned: Women who are foreign nationals are found in full and part-time employment in similar proportions. Just like foreign nationals in general, they are also represented among the managers (that is, in the "leading positions") at a slightly higher percentage than among the supervisors. This group of employees may have special competencies and/or resources relevant to the job. The fact that more women than men among foreign nationals hold an academic qualification speaks for that. The proportion of foreign nationals with no formal vocational qualification is also above average. The few occupational positions where no formal vocational qualification is required are therefore disproportionately filled by foreign nationals.

3.1.1 Results regarding the status quo

The key findings regarding the status quo in battery cell manufacturing are presented below for the sector “Manufacture of batteries and accumulators” (based on statistics for the economic activity (WZ) category 272, see German Federal Statistical Office 2008¹⁷). The figures were received from a special analysis of the employment statistics¹⁸ by the German Federal Employment Agency (see Section 3.1.2.).

Below average representation of women in battery cell manufacturing, mainly employed part-time – however, proportion of women higher compared to STEM occupations in general

In the sector “Manufacture of batteries and accumulators”, women are significantly under-represented at 24% in 2021 compared to the labour market as a whole. They are found particularly often in part-time employment (see Figure 3). The German labour market as a whole had 33.4 million employees subject to social insurance in 2021. 15.5 million of them were women, corresponding to a proportion of about 46%. 49% of all working women were employed part-time. The proportion of part-time employment for working men was 12% (Federal Employment Agency 2022a¹⁹).

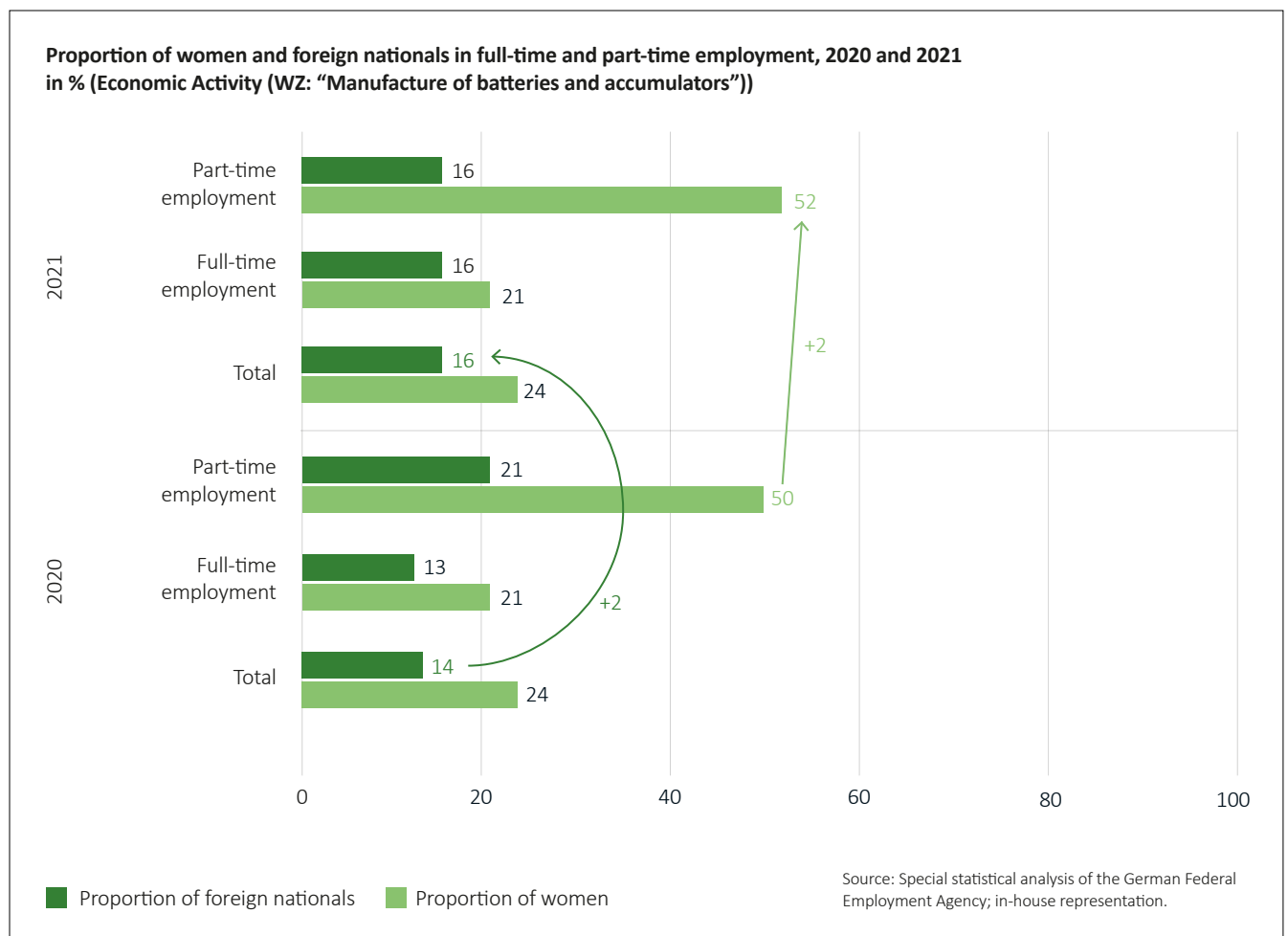


Figure 3: Proportion of women and foreign nationals in full-time and part-time employment, 2020 and 2021 in percent (Economic Activity (WZ): “Manufacture of batteries and accumulators”). Reading example (2020): Among part-time employees (=100%), 50% are women and 50% are men. Among part-time employees (=100%), 21% are foreign nationals and 79% are Germans.

17 Federal Statistical Office of Germany (2008): Klassifikation der Wirtschaftszweige 2008 (WZ 2008). Published by Federal Statistical Office of Germany. Wiesbaden. Available at: <https://www.destatis.de/static/DE/dokumente/klassifikation-wz-2008-3100100089004.pdf>, accessed: 23.08.2022.

18 See https://statistik.arbeitsagentur.de/DE/Statischer-Content/Grundlagen/Definitionen/Generische-Publikationen/Kurzinformation-Beschaeftigungsstatistik.pdf;jsessionid=246EE8C9EEA187654C256A83AC43B909?__blob=publicationFile&v=10 [Accessed on 24.03.2023]

19 Federal Employment Agency (2022a): Reports: Blickpunkt Arbeitsmarkt – Die Arbeitsmarktsituation von Frauen und Männern. Federal Employment Agency. Nuremberg. Available at: https://statistik.arbeitsagentur.de/DE/Statischer-Content/Statistiken/Themen-im-Fokus/Frauen-und-Maenner/generische-Publikationen/Frauen-Maenner-Arbeitsmarkt.pdf?__blob=publicationFile, accessed: 28.09.2022.

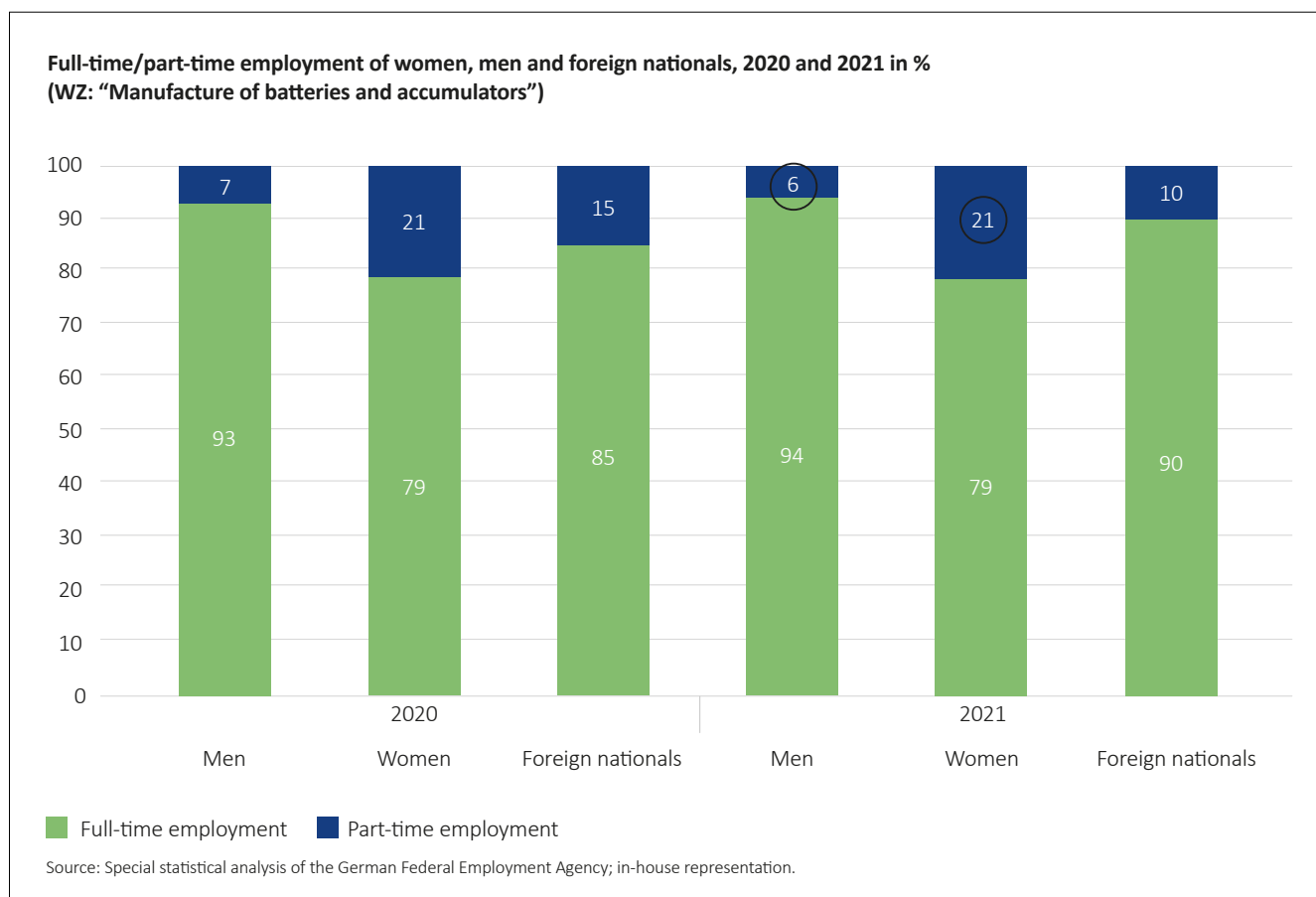


Figure 4: Full-time/part-time employment of women, men and foreign nationals, 2020 and 2021 in percent (WZ: "Manufacture of batteries and accumulators"). Reading example (2020): Among men (=100%), 93% are employed full-time and 7% part-time.

21% of women but only 6% of men in the economic sector under consideration were employed part-time in 2021 (Figure 4). However, the proportion of part-time employment is significantly lower for both women and men compared to the labour market as a whole. The proportion of women is also slightly higher in this specific economic sector than the proportion of women in STEM occupations in general. In STEM occupations, i.e. science, technology, engineering and mathematics, the proportion of women was 17% in 2021. The most marked differences are found in technology occupations (14.2% women), while the gender ratio is nearly balanced in mathematics and science (Federal Employment Agency 2022a²⁰). This indicates possible potential for the integration of women in the sector "Manufacture of batteries and accumulators". Battery cell production may offer better

opportunities for women than other STEM occupations, for instance regarding the possibility of working part time.

The gender ratio in the economic sector under consideration is nearly balanced for part-time employees as shown in Figure 3. In fact, the proportion of women increased slightly by 2 percentage points in the two years in question. The proportion of women among part-time employees was 52% in 2021. This increase in part-time employment for women is comprised of German women only (not foreign nationals) (see Table 1 and Table 2, Section 3.1.2.). Longer time series would be required to determine the extent to which this change goes beyond a mere random fluctuation²¹.

20 Federal Employment Agency (2022a): Reports: Blickpunkt Arbeitsmarkt – Die Arbeitsmarktsituation von Frauen und Männern. Federal Employment Agency, Nuremberg. Available at: https://statistik.arbeitsagentur.de/DE/Statischer-Content/Statistiken/Themen-im-Fokus/Frauen-und-Maenner/generische-Publikationen/Frauen-Maenner-Arbeitsmarkt.pdf?__blob=publicationFile, accessed: 28.09.2022.

21 This may also be indicative of a slight trend towards more traditional roles, which was observed during the pandemic: Women bore the brunt of additional childcare responsibilities due to the temporary closure of day-care centres and schools during the pandemic. This caused traditional gender roles in families to "creep back in"; see Kohlrausch and Zucco 2020.

Proportion of foreign nationals corresponds to average in the labour market as a whole – with slightly rising trend, especially for full-time employees

In Germany's labour market as a whole, foreign nationals accounted for 13% of the employees subject to social insurance in both 2020 and 2021²². Values in the sector "Manufacture of batteries and accumulators" were similar. However, their proportion out of all employees in this sector increased from 14% to 16% in 2020 and 2021 (see Figure 3). Remarkably, foreign nationals account for 73% of the industry's total increase in personnel from 2020 to 2021 (figures not shown). These observations may indicate that recruiting measures for employees from abroad are taking effect.

Foreign nationals at 21% were represented among part-time employees at a higher percentage than among full-time employees in the sector "Manufacture of batteries and accumulators" in 2020. However, the percentage difference for foreign nationals is less severe between full-time and part-time than the difference for women (see Figure 3). The proportion of foreign nationals also decreased slightly for part-time employment and increased slightly for full-time employment between the years, from 13% to 16%. With cautious interpretation, the figures indicate more of a tendency towards increased representation for the group of foreign nationals in the examined industry than for women. Longer time series are needed to determine whether this is an actual trend.

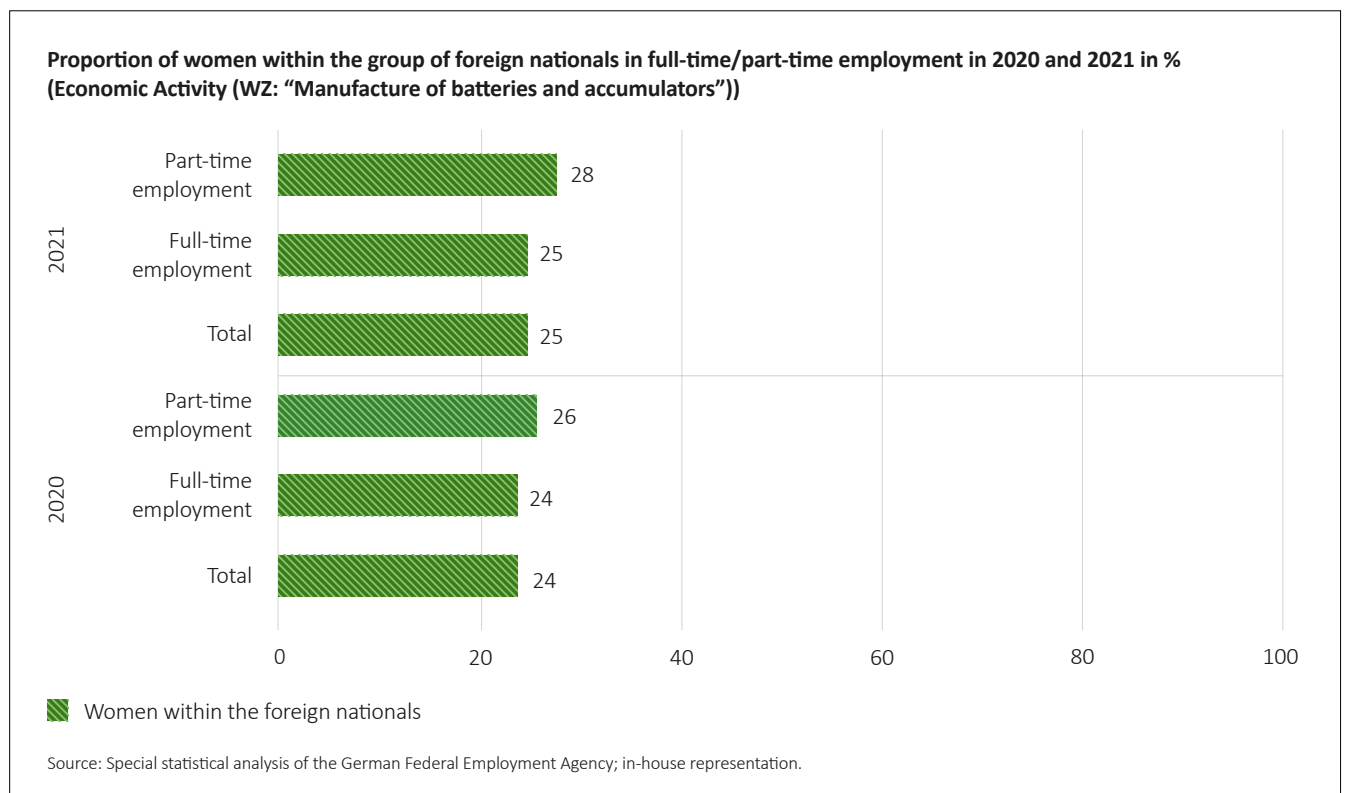


Figure 5: Proportion of women within the foreign nationals group by full-time/part-time employment, 2020 and 2021 in percent (WZ: "Manufacture of batteries and accumulators"). Reading example (2020): Within the group of foreign nationals in part-time employment, women account for 26% and men for 74% (=100%).

²² Reporting date 30 June, see. <https://www.destatis.de/DE/Themen/Arbeit/Arbeitsmarkt/Erwerbstaetigkeit/Tabellen/insgesamt.html> [Accessed on 24.03.2023]

Foreign national women are more frequently in full-time employment compared to all women

Definition of intersectionality

The concept of intersectionality describes the ways in which systems of inequality based on gender, race, ethnicity, sexual orientation, gender identity, disability, class and other forms of discrimination “intersect” to create unique dynamics and effects²³.

The “intersectional” view,²⁴ meaning the proportion of women within the group of foreign nationals, exhibits a value similar to the general proportion of women in the economic sector under consideration. The proportion of women among foreign nationals was 25% in 2021 (Figure 5).²⁵

Within the foreign nationals group, women in the economic sector under consideration are however found comparatively often in full-time employment. They accounted for 25% of the full-time employees in 2021. Foreign nationals account for all of the increase in full-time employment among women (see Table 1 and Table 2, Section 3.1.2.). Since they made up 28% of the part-time employees, the percentage difference between full-time and part-time employment is comparatively small. Within the group of foreign nationals employed in this economic sector, women are therefore found at a lower percentage in employment relationships “typical” for women with regard to their working time (in view of the part-time/full-time volume of work).

Women, men and foreign nationals have similar academic qualification – foreign nationals more frequently have no vocational qualification

Excursus: Legitimation of occupational qualifications

People from third countries who want to engage in a regulated occupation in Germany must have their foreign education and training/graduate degree recognised. Recognition is not required to engage in non-regulated occupations. However, recognition is generally the prerequisite for a residence permit when people want to immigrate to Germany from third countries.

Comparatively few differences exist between the comparison groups (women, men, foreign nationals) in the academic qualification segment. However, differences can be observed in the “lower” qualification segment, to the detriment of women and especially foreign nationals. The few occupational positions where no formal vocational qualification is required are filled by under-represented groups with above-average frequency. Filling such positions should not result in systematic discrimination. Education and training opportunities should be offered within companies for this group of employees to protect jobs.

Women and men employed in the sector “Manufacture of batteries and accumulators” have a similar level of qualification. Around 20% of both the men and the women (2021) hold an academic qualification, and only a small proportion (women: 12%; men: 10%) have no vocational qualification (Figure 6).

This corresponds to the level of education and training for women and men in Germany’s labour market as a whole. They are similarly well positioned. Depending on the qualification dimension under consideration (academic or vocational qualification) and the age bracket, women have actually surpassed men (Lott et al. 2022²⁶). The proportion of women also increases with the level of qualification in the

23 See <https://www.intersectionaljustice.org/what-is-intersectionality> [Accessed on 13.10.2022]

24 For more information about the intersectional perspective, see <https://www.diversity-challenge.de/diversityaktionsbox/diversityverstehen/diversity-1x1/entdecken-vielfaltsgesellschaft/die-intersektionale-perspektive/> [Accessed on 24.03.2023]

25 For comparison: Around 37% of women were in the group of foreign nationals subject to social insurance in Germany’s labour market as a whole in 2021; reporting date 30 June, see <https://www.destatis.de/DE/Themen/Arbeit/Arbeitsmarkt/Erwerbstaetigkeit/Tabellen/insgesamt.html> [Accessed on 24.03.2023]. The countries of origin always have to be considered in such comparisons as well. In the examination of all employees in the German labour market, the most common countries of origin for both women and men are Turkey, Romania and Poland; see German Federal Employment Agency 2022a.

26 Lott, Yvonne; Hobler, Dietmar; Pfahl, Svenja; Unrau, Eugen (2022): Stand der Gleichstellung von Frauen und Männern in Deutschland. Düsseldorf (WSI Report, 72). Available at: https://www.boeckler.de/de/faust-detail.htm?sync_id=HBS-008259, last update: 30.09.2022, accessed: 30.09.2022.

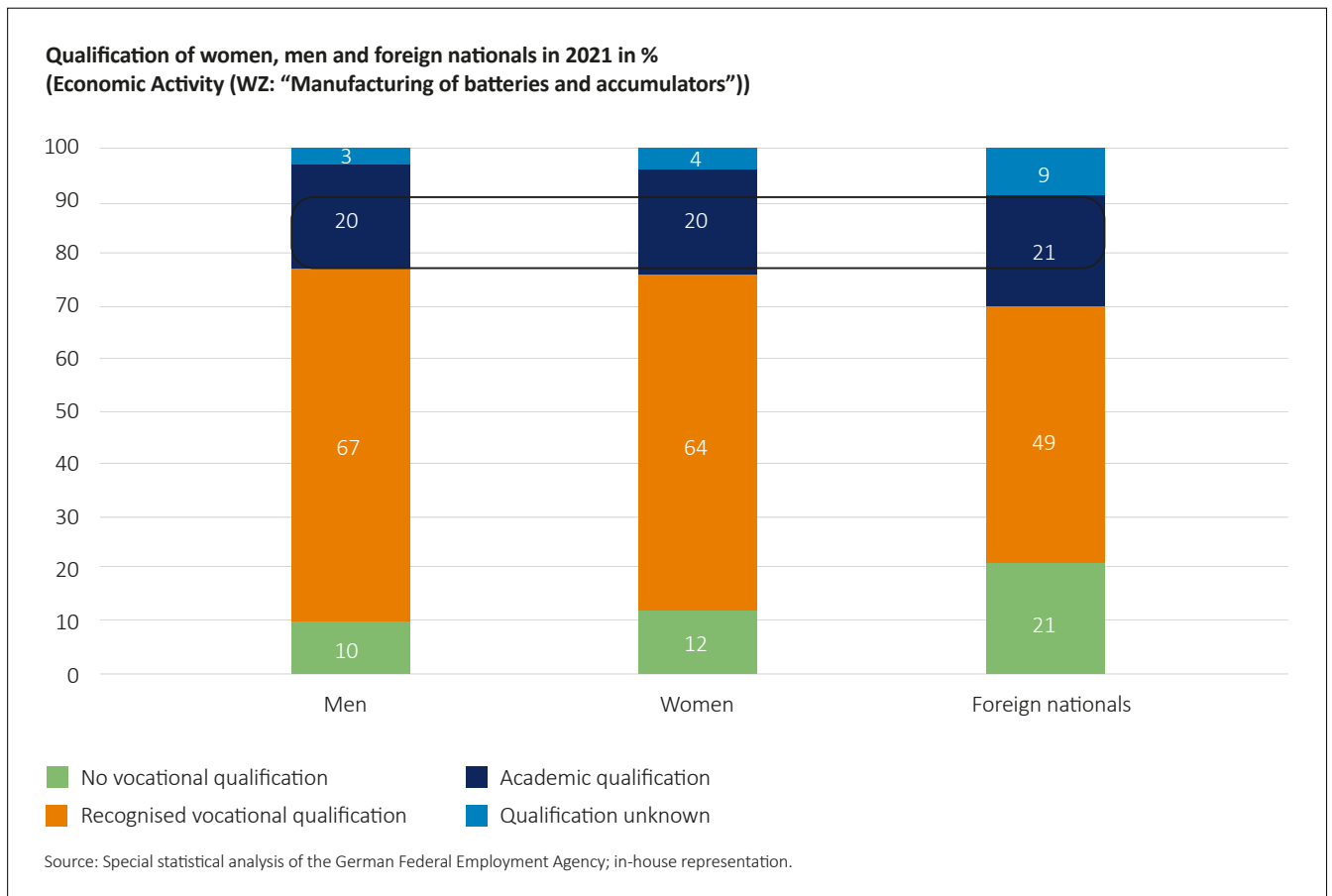


Figure 6: Qualification of women, men and foreign nationals, 2021 in percent (WZ: "Manufacture of batteries and accumulators"). Reading example: Among men (=100%), 10% have no vocational qualification, 67% have a recognised vocational qualification and 20% have an academic qualification. The qualification of 3% of the men is unknown.

STEM occupations of the German labour market (Federal Employment Agency 2022a²⁷).

However, the proportion with no vocational qualification is higher for foreign nationals in the battery sector at 21% (2021). Correspondingly, only 49% of foreign nationals have a recognised vocational qualification (compared to around 65% of German men and women), but 21% have an academic qualification, a frequency similar to that for women and men. Remarkably, the amount of foreign nationals who have an academic qualification increased by 35% from 2020 to 2021 (figures not shown). This observation goes in line with the generally increasing polarisation in the qualification level of immigrants seen in recent years, with many highly qualified people but also large numbers without any formal vocational qualification (Baas 2021²⁸). Information on the

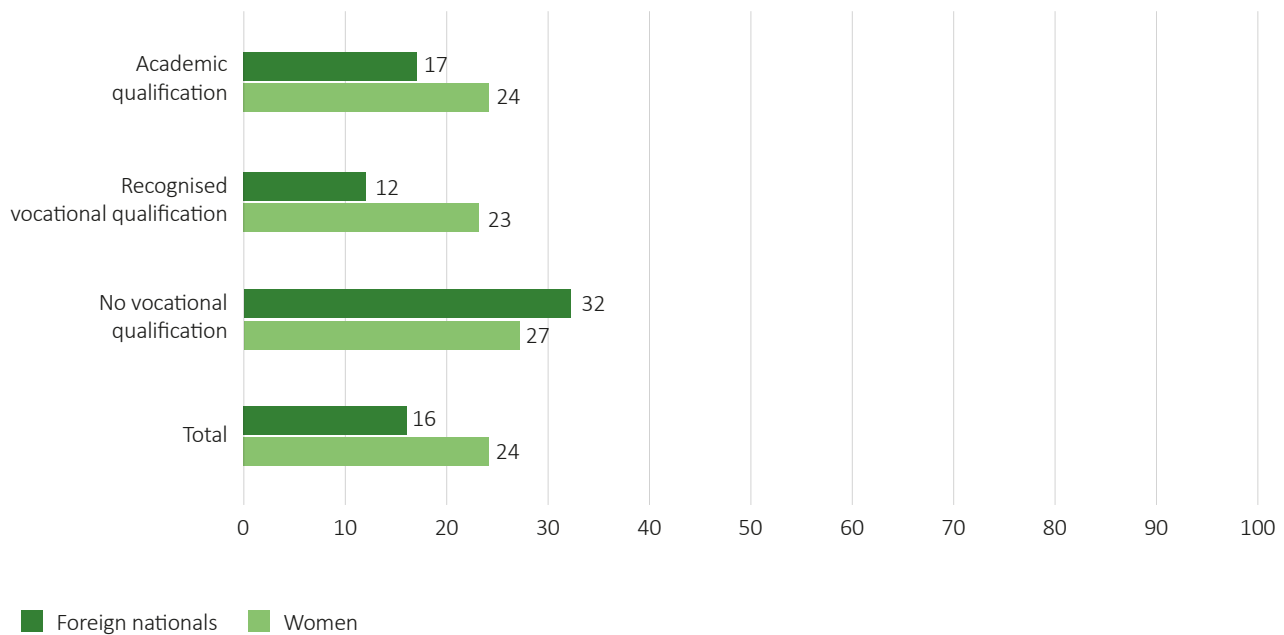
qualification of foreign nationals (9%) is also comparatively often unavailable (Figure 6).

A more detailed examination of people by qualification shows that the proportion of women at 27% is highest within the group with no vocational qualification compared to the other groups (Figure 7). This is because the number of cases is small for the employee group with no vocational qualification, so that even smaller deviations carry considerably more weight.

27 Federal Employment Agency (2022a): Reports: Blickpunkt Arbeitsmarkt – Die Arbeitsmarktsituation von Frauen und Männern. Federal Employment Agency, Nuremberg. Available at: https://statistik.arbeitsagentur.de/DE/Statischer-Content/Statistiken/Themen-im-Fokus/Frauen-und-Maenner/generische-Publikationen/Frauen-Maenner-Arbeitsmarkt.pdf?__blob=publicationFile, accessed: 28.09.2022.

28 Baas, Meike (2021): Bildungsbeteiligung nach Migrationshintergrund. In: WISTA (2/2021). Available at: https://www.destatis.de/DE/Methoden/WISTA-Wirtschaft-und-Statistik/2021/02/bildungsbeteiligung-022021.pdf?__blob=publicationFile, accessed: 29.11.2022.

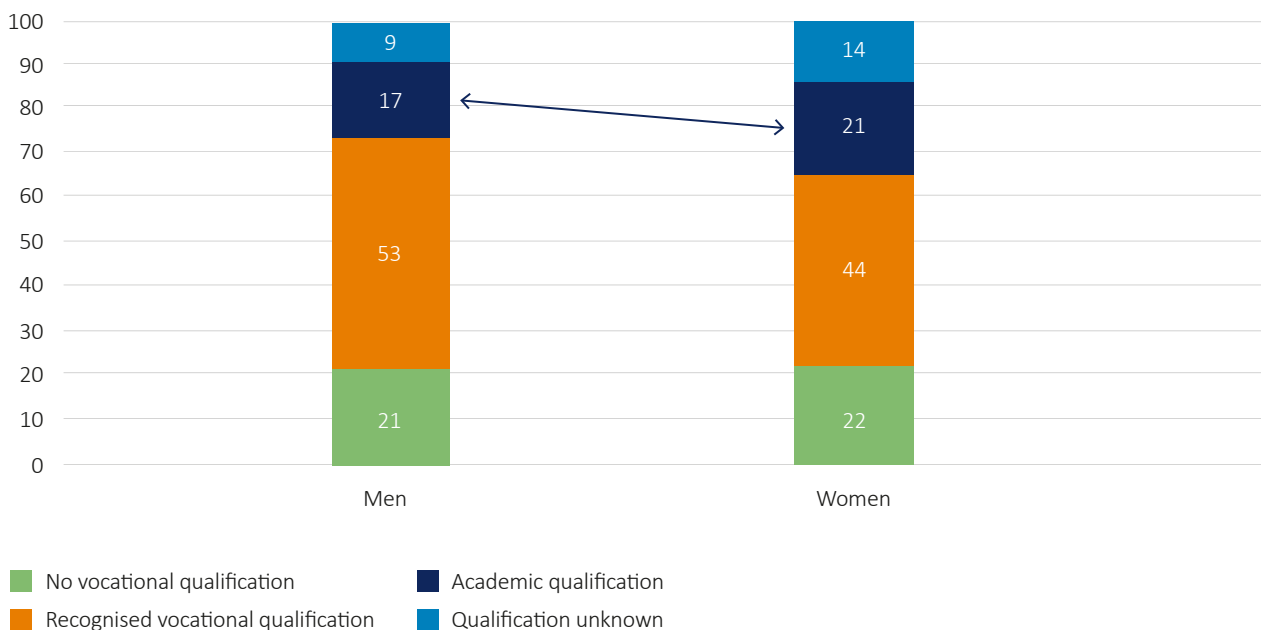
**Proportion of women and foreign nationals with respect to all employees categorised by their qualification 2021 in %
(Economic Activity (WZ: "Manufacture of batteries and accumulators"))**



Source: Special statistical analysis of the German Federal Employment Agency; in-house representation.

Figure 7: Proportion of women and foreign nationals out of employees, according to qualification, 2021 in percent (WZ: "Manufacture of batteries and accumulators"). Reading example: Of the employees with no vocational qualification (=100%), 27% are women and 73% are men. Also, of the employees with no vocational qualification (=100%), 32% are foreign nationals and 68% are Germans.

**Occupational qualification within the group of foreign nationals categorised by gender 2021 in %
(Economic activity (WZ: "Manufacture of batteries and accumulators"))**



Source: Special statistical analysis of the German Federal Employment Agency; in-house representation.

Figure 8: Qualification within the foreign nationals group by gender, 2021 in percent (WZ: "Manufacture of batteries and accumulators"). Reading example: Among men who are foreign nationals (=100%), 21% have no vocational qualification, 53% have a recognised vocational qualification, 17% have an academic qualification and the qualification of 9% is unknown.

A higher percentage of women than men have an academic qualification among foreign nationals

An aspect that stands out in the intersectional examination (gender composition within the foreign nationals group) (Figure 8) is that more women (21%) than men (17%) who are foreign nationals have an academic qualification. Correspondingly women at 29% account for a relatively high proportion of the foreign nationals with an academic qualification in comparison to other groups (Figure 9). Additional analyses would be required to determine the composition of this group, for example, whether the women mainly come from certain countries of origin. The data do however indicate that this is a highly selective group of people, who may bring specific competencies and/or resources with them. Among men who are foreign nationals, qualifications in the “middle” educational segment predominate.

Few supervisors and managers are women or foreign nationals – comparatively high proportion of women among foreign nationals in management positions

Leadership positions in the labour market as a whole continue to be frequently filled by men.²⁹ 28% of employees with supervisory and management functions in Germany’s labour market were women in 2021 (Federal Employment Agency 2022a³⁰). The proportion of women in leadership positions also varies by industries: Sectors that generally employ more women also tend to have a higher percentage of leadership positions filled by women, for instance in healthcare (2022: 36.9% women; for comparison: 9.7% in the building trade).³¹

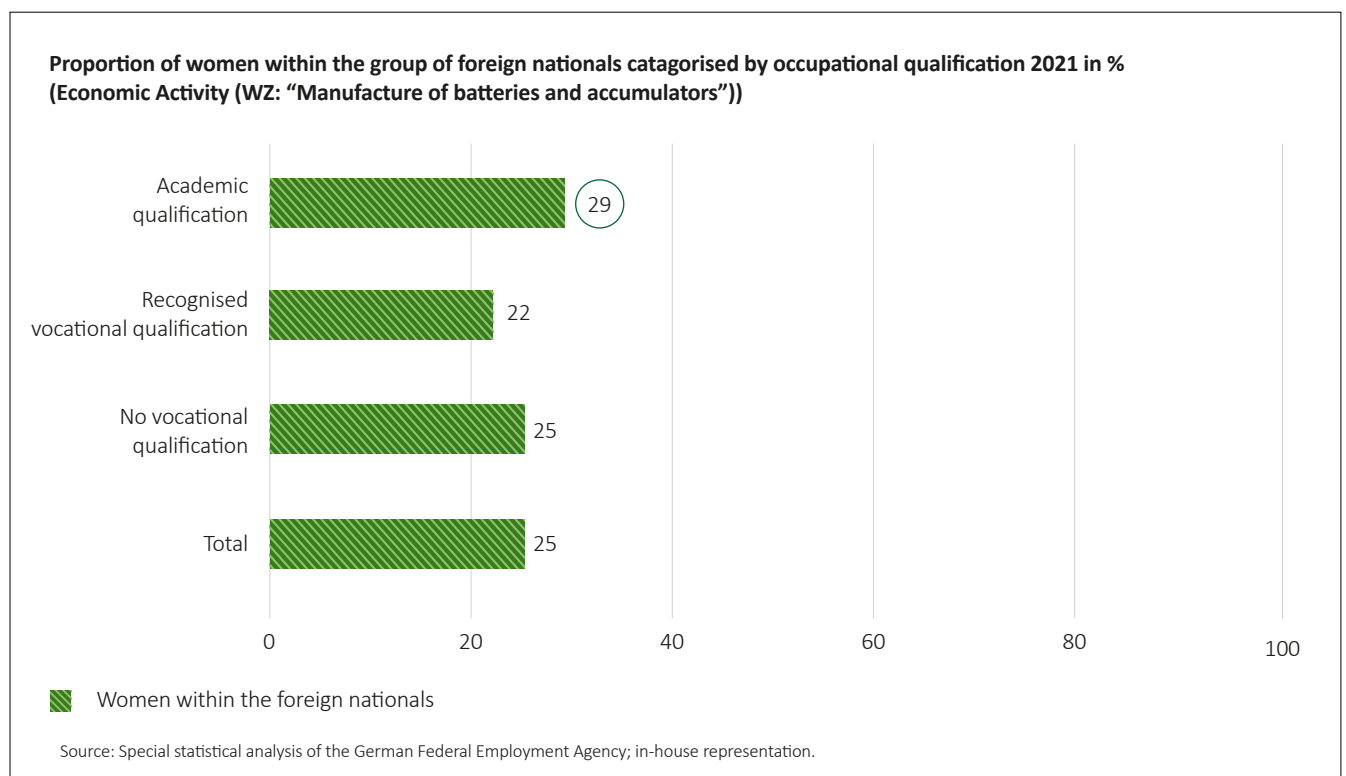


Figure 9: Proportion of women within the foreign nationals group by qualification, 2021 in percent (WZ: “Manufacture of batteries and accumulators”). Reading example (2020): Of the employees who are foreign nationals have an academic qualification (=100%), 29% are women and 71% are men.

29 Regarding these figures, note that deviations are possible between the examined studies depending on the definition of the term “leadership position” and the underlying dataset.

30 Federal Employment Agency (2022a): Reports: Blickpunkt Arbeitsmarkt – Die Arbeitsmarktsituation von Frauen und Männern. Federal Employment Agency, Nuremberg. Available at: https://statistik.arbeitsagentur.de/DE/Statischer-Content/Statistiken/Themen-im-Fokus/Frauen-und-Maenner/generische-Publikationen/Frauen-Maenner-Arbeitsmarkt.pdf?__blob=publicationFile, accessed: 28.09.2022.

31 <https://de.statista.com/statistik/daten/studie/575509/umfrage/frauenanteil-in-fuehrungspositionen-in-deutschland-nach-branchen/> [Accessed on 24.03.2023].

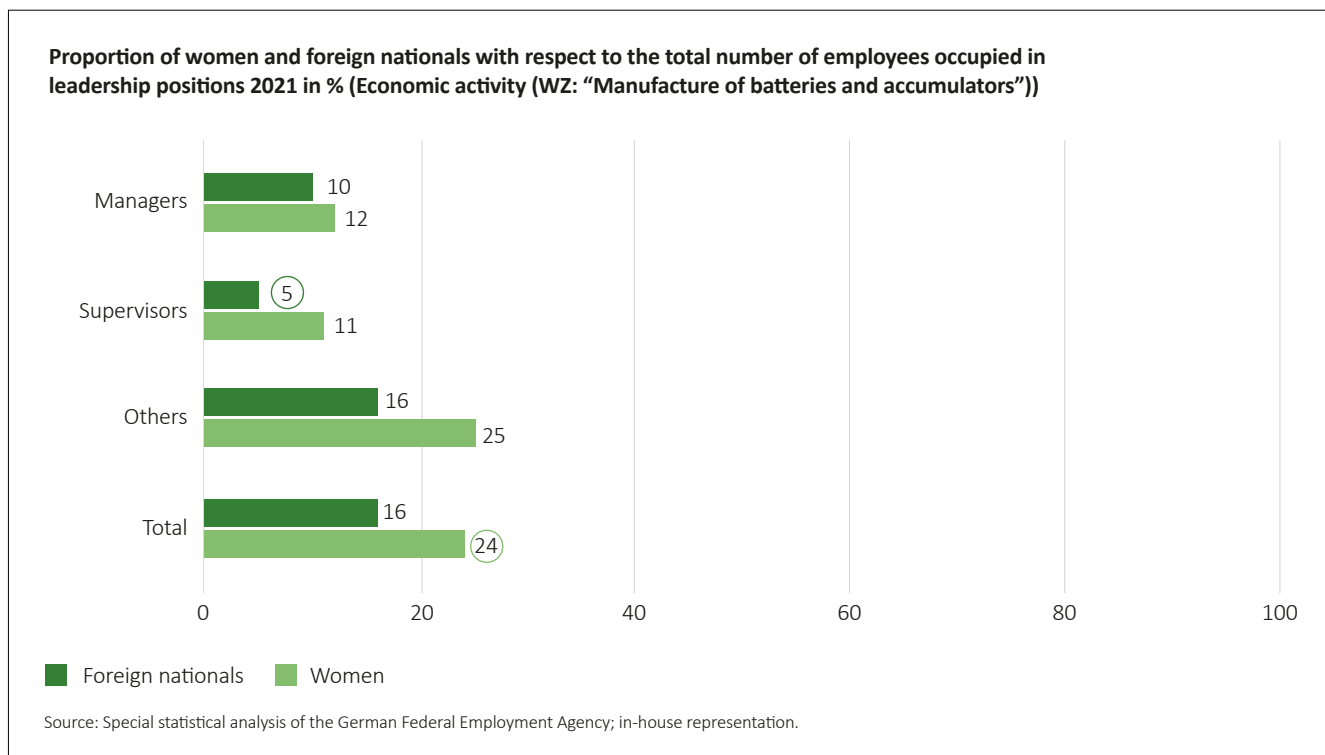


Figure 10: Proportion of women and foreign nationals out of employees in leadership positions, 2021 in percent (WZ: "Manufacture of batteries and accumulators"). Reading example: Of the supervisors (=100%), 11% are women and 89% are men. Also, of the supervisors (=100%), 5% are foreign nationals and 95% are Germans.

This tendency is also reflected by the sector "Manufacture of batteries and accumulators": In this economic sector, with a comparatively low proportion of women in general at 24% (2021), only 11% (supervisors)³² and 12% (managers)³³ of the leadership positions were filled by women in 2021 (Figure 10). Correspondingly, only 3% of the women are in supervisory or leadership positions, while 8% of the men employed in this sector hold such a position (Figure 11).

The proportion of foreign nationals in leadership positions is even lower, especially for supervisors (5%). This also agrees with the data for Germany as a whole, which shows that the representation of people with a migration background, for example, decreases significantly with higher levels of employment in the sector under consideration (Destatis and WZB 2021³⁴). The proportion of foreign nationals is however somewhat higher among managers compared to supervisors, and at a similar level as the proportion of women. Further analyses would be required here as well to uncover

additional information, for example, about the country of origin or specific competencies.

In the intersectional examination, the presumably highly selective group of women who are foreign nationals is also reflected by the occupational status (Figure 12): Within the managers group, the proportion of women among the foreign nationals is 19%, which is higher compared to the supervisors. This is supported by the observation that more women than men who are foreign nationals hold an academic degree (see above). It can be assumed that these highly qualified women who are foreign nationals are also found in the managers group.

32 Defined as follows in the special analysis: Supervisors are specialists with a management function. They undertake tasks that require specialised knowledge and skills, for example, in the commercial and business administration field or in the organisational and administrative field. They assume responsibility for planning and organisation, and supervise the employees in their department or section.

33 Defined as follows in the special analysis: Managers are experts with a management function. They undertake tasks with a high degree of complexity. They manage companies and organisations, and assume responsibility for employee recruitment and leadership, targets and quality management, budget planning and resource efficiency.

34 Destatis; WZB, BiB (Publisher) (2021): Datenreport 2021. Ein Sozialbericht für die Bundesrepublik Deutschland. Available at: https://www.destatis.de/DE/Service/Statistik-Campus/Datenreport/Downloads/datenreport-2021.pdf;jsessionid=E47A6789A8F0755B45CEDC61618D9CE0.live711?__blob=publicationFile, accessed: 04.08.2022.

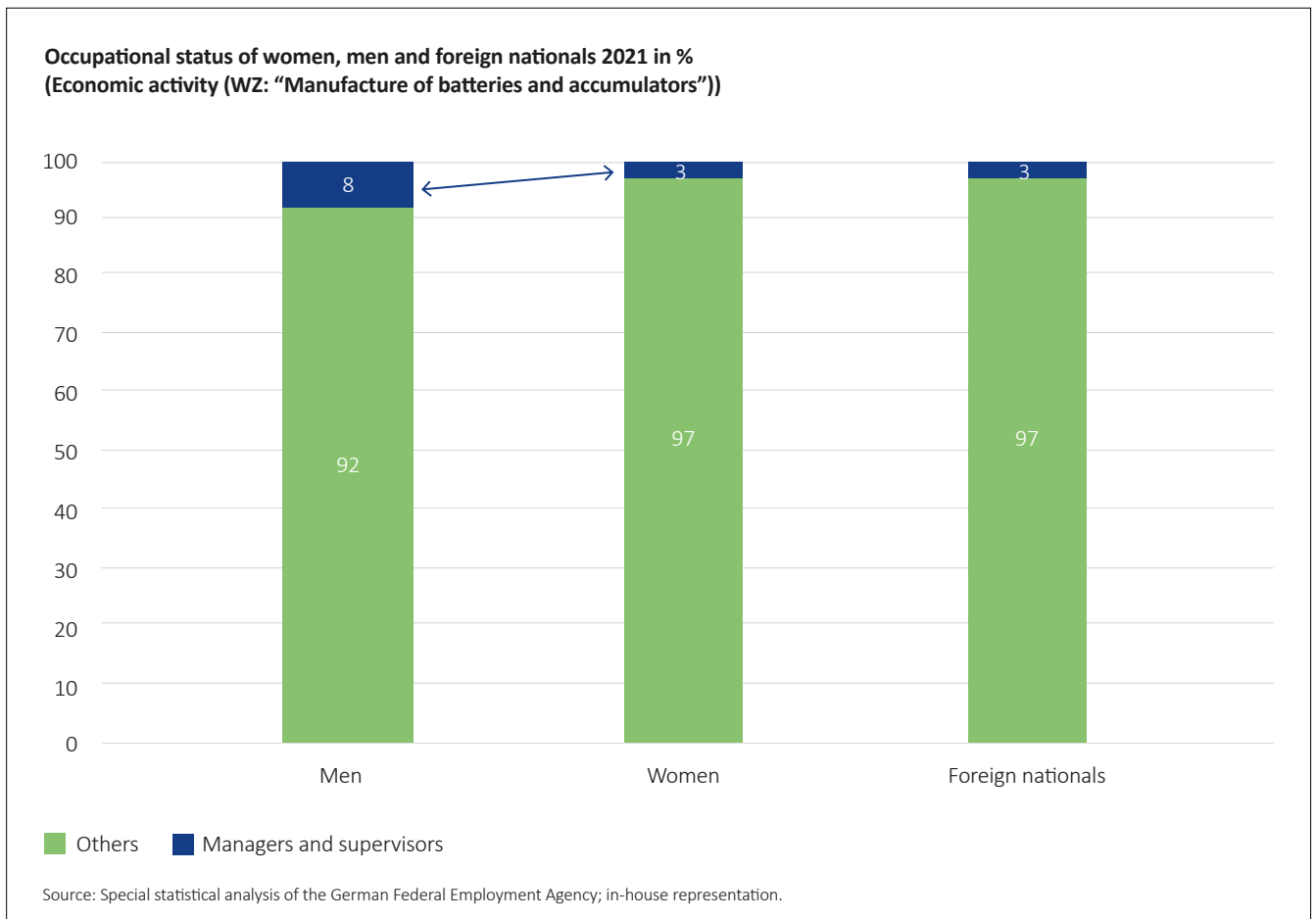


Figure 11: Occupational status of women, men and foreign nationals, 2021 in percent (WZ: "Manufacture of batteries and accumulators").
Reading example: Of the men (=100%), 8% are supervisors or managers and 92% hold a different occupational position.

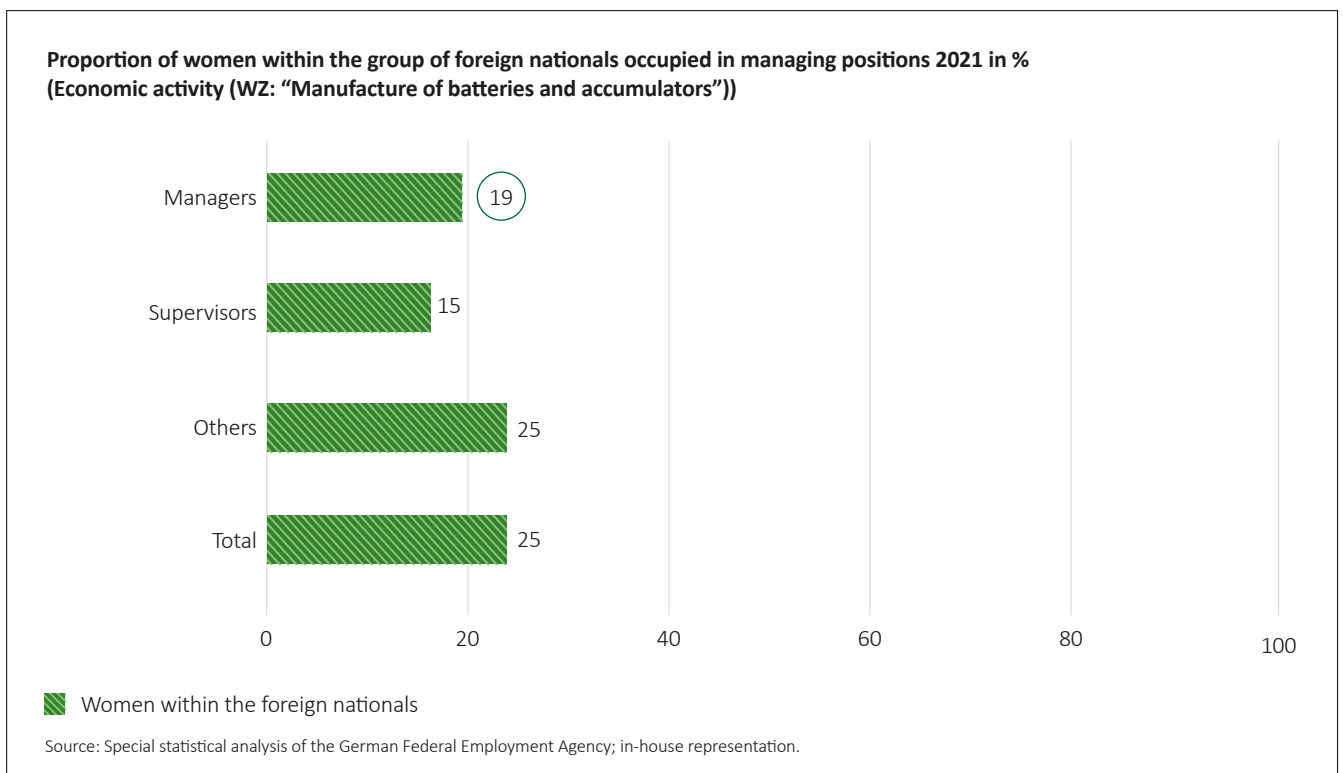


Figure 12: Proportion of women within the foreign nationals group by leadership positions, 2021 in percent (WZ: "Manufacture of batteries and accumulators").
Reading example (2020): Of the supervisors who are foreign nationals (=100%), 15% are women and 85% are men.

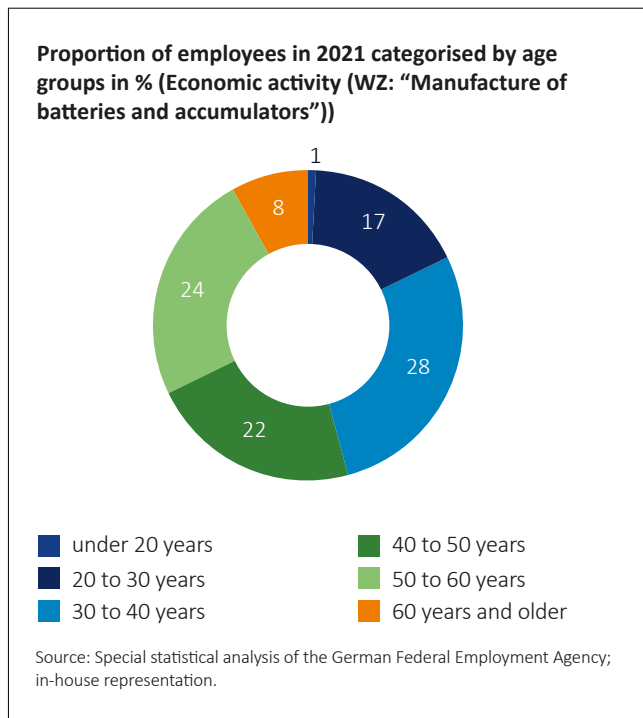


Figure 13: Proportion of employees by age groups in years, 2021 in percent (WZ: "Manufacture of batteries and accumulators").

Fewer older employees compared to the labour market as a whole – women are found less often than men in the high-intensity family age phase

The age diversity in 2021 was 7.4% (figures not shown). Thus the age structure is by all means diverse. The lower the standard deviation, the more evenly the employees are distributed across the age groups.³⁵

In battery cell manufacturing, the sector under consideration, the age group of 30 to 40 years was represented with the highest percentage frequency in 2021 (see Figure 13). These values approximately agree with those of Germany's labour market as a whole, where 23% of employees were aged 30 to 40 years in 2022. The percentage of women in the age group of 30 to 40 years is slightly lower than the percentage of men (Figure 14). Presumably women in this age group face special challenges regarding career/family balance, also in battery cell manufacturing.

Employees in the age group from 40 to 50 years are less frequently represented at 22%. This is also observed in Germany as a whole³⁶ presumably caused by health impairments, less gainful employment and a reduction in earning capacity. Interestingly, women are represented at a

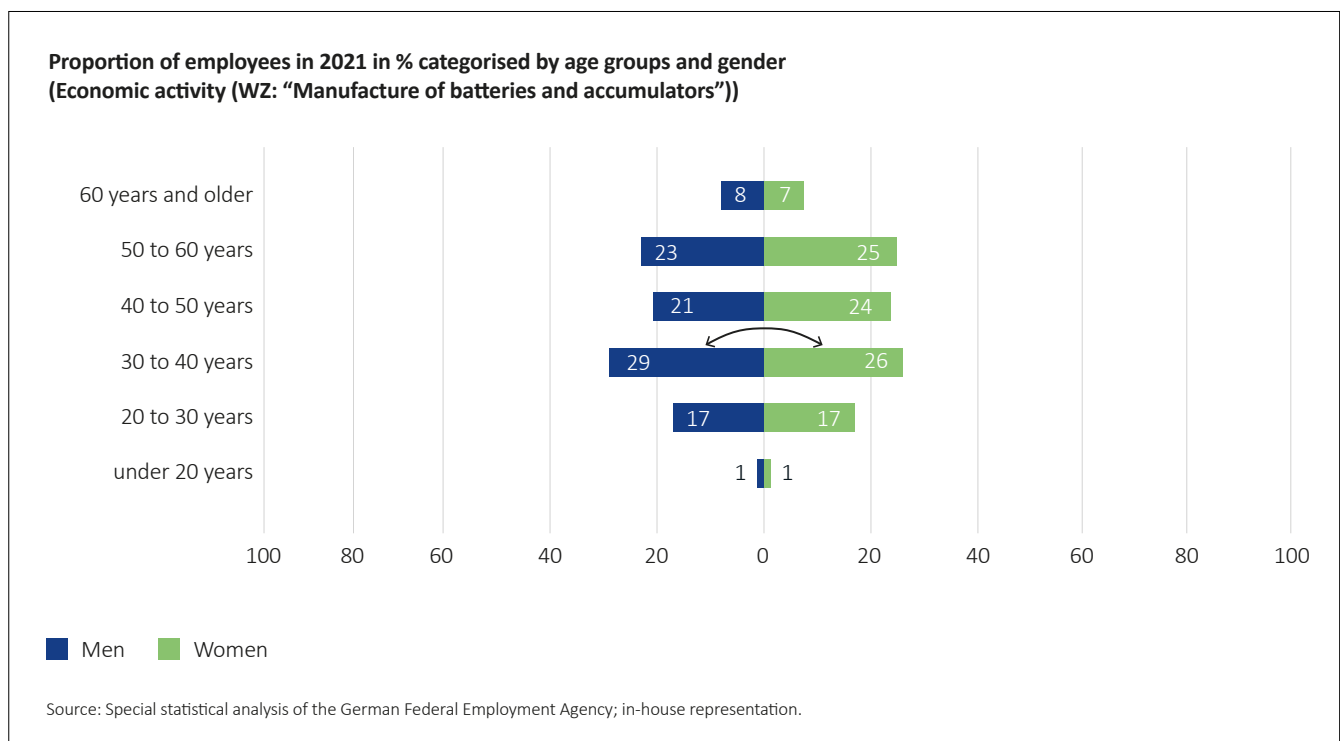


Figure 14: Proportion of employees by age groups in years and by gender, 2021 in (WZ: "Manufacture of batteries and accumulators").

³⁵ The diversity of the age structure is represented by the standard deviation of the mean of the proportions in the age categories (<20 years, 21-30 years, 31-40 years, 41-50 years, 51-60 years, > 60 years). A lower standard deviation represents a more even distribution across the age categories (high age diversity), while a higher standard deviation represents a more uneven distribution across the age categories (lower age diversity).

³⁶ <https://www.destatis.de/DE/Themen/Arbeit/Arbeitsmarkt/Erwerbstaetigkeit/Tabellen/altersgruppen.html> [Accessed on 24.03.2023]

higher percentage than men in the age group from 40 to 60 years. Possibly men are more likely to leave a company in middle age, to be head-hunted or to continue their career elsewhere, while women tend to start a new job after the family-intensive phase.

Around 8% of the employees in battery cell production, the sector under consideration, are of greater age (60 years and up). Here the percentage of older employees is somewhat lower compared to the German labour market as a whole. Nearly 10% of employees in Germany as a whole were 60 years and older in 2022.³⁷ To retain this group up to retirement age, workplaces should be adapted to the needs of older employees.

Gender pay gap in battery cell manufacturing similar to the German labour market as a whole

Women continue to earn less on average than men in Germany overall. This is also the case in the sector “Manufacture of batteries and accumulators” (see Figure 15): Here the gender pay gap was 18% in 2021.³⁸ With average gross monthly earnings of 3,221 euros (median), women earned approximately 18 percentage points less than men with average gross monthly earnings of 3,945 euros. The 2021 figures for the labour market as a whole are similar. Here the gender pay gap was also 18%. This means that women earned 18% less than men on average in reference to the gross hourly earnings (Federal Statistical Office of Germany

2022³⁹). However, caution is required in comparing these figures due to the different operationalisation of earnings: The gross monthly earnings of full-time employees were used in the special analysis examined here. This means the figures are based on different populations and different operationalisations of earnings. Nevertheless, there is at least no serious deviation from the picture across all industries here. Data for the labour market as a whole show that the difference in earnings, among other things, can be traced back to the fact that women are more likely to be employed in sectors and occupations with lower pay, and less often as managers. The “adjusted” gender pay gap, where these explanatory factors have been excluded, was still 6% in 2018 (unadjusted value: 20%) (Federal Statistical Office of Germany 2022⁴⁰). To what extent this value is due to discrimination or can be traced back to other, unobserved characteristics, for example, in the work history, remains unclear. Thus it can be interpreted as the “upper limit” for discrimination.

Further analyses are required to determine to what extent the gender pay gap in the sector “Manufacture of batteries and accumulators” is due to observable characteristics, such as qualifications, and thus what the adjusted gender pay gap is. Implicitly the value is already adjusted for industry effects, since only earnings within one industry were compared here.

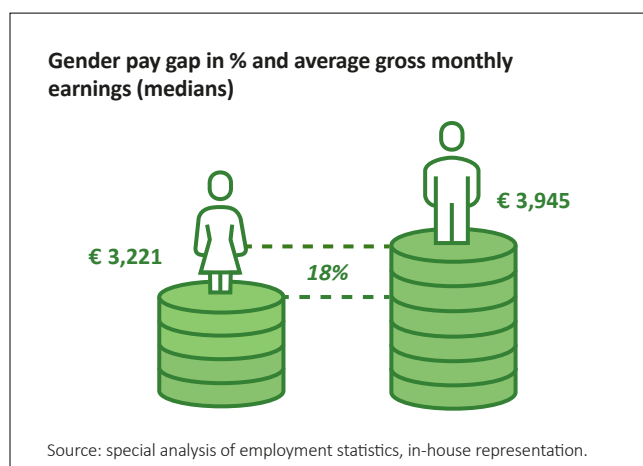


Figure 15: Gender pay gap in percent and average gross monthly earnings (medians); source: special analysis of employment statistics, in-house representation.

37 <https://www.destatis.de/DE/Themen/Arbeit/Arbeitsmarkt/Erwerbstaetigkeit/Tabellen/altersgruppen.html> [Accessed on 24.03.2023]

38 The gender pay gap is calculated as the difference between the average earnings of men and women in proportion to the average earnings of men.

39 Federal Statistical Office of Germany (2022): Gender Pay Gap 2021: Frauen verdienten pro Stunde weiterhin 18 % weniger als Männer. Pressemitteilung Nr. 088 vom 7. März 2022. Published by Federal Statistical Office of Germany, Wiesbaden. Available at: https://www.destatis.de/DE/Presse/Pressemitteilungen/2022/03/PD22_088_621.html, last update: 07.03.2022, accessed: 10.08.2022.

40 Federal Statistical Office of Germany (2022): Gender Pay Gap 2021: Frauen verdienten pro Stunde weiterhin 18 % weniger als Männer. Pressemitteilung Nr. 088 vom 7. März 2022. Published by Federal Statistical Office of Germany, Wiesbaden. Available at: https://www.destatis.de/DE/Presse/Pressemitteilungen/2022/03/PD22_088_621.html, last update: 07.03.2022, accessed: 10.08.2022.

3.1.2 Methodology and approach for the analysis of employment statistics of the German Federal Employment Agency

How were the data recorded and prepared?

The figures regarding the representation of women, older people and foreign nationals in the sector “Manufacture of batteries and accumulators” (based on the statistics of the economic activity WZ category 272, see German Federal Statistical Office 2008⁴¹) were received from a special analysis of employment statistics⁴² provided by the German Federal Employment Agency.

Table 1 and Table 2 provide an overview of the corresponding variables and number of cases included in 2020 and 2021. The very small number of cases for women and foreign nationals among supervisors and managers stands out. Women who are foreign nationals are found here at a particularly low frequency. Accordingly, the corresponding analyses have to be interpreted with caution since they are based on a small number of cases.

2020	Total			Of which foreign nationals		
	Total	Of which		Total	Of which	
		Men	Women		Men	Women
Total	13,361	10,159	3,202	1,871	1,423	448
Full-time employment	12,020	9,494	2,526	1,595	1,218	377
Part-time employment	1,341	665	676	276	205	71
No vocational qualification	1,399	1,012	387	396	298	98
Recognised vocational qualification	9,058	6,955	2,103	944	749	195
Academic qualification	2,477	1,891	586	340	247	93
Qualification unknown	427	301	126	191	129	62
Supervisors	386	343	43	14	11	3
Managers	505	456	49	57	48	9
Under 20 years	166	133	33	6	6	-
20 to under 30 years	2,327	1,786	541	451	363	88
30 to under 40 years	3,763	2,911	852	615	474	141
40 to under 50 years	2,852	2,097	755	478	333	145
50 to under 60 years	3,245	2,443	802	273	207	66
60 years and over	1,008	789	219	48	40	8

Source: Special statistical analysis of the German Federal Employment Agency; in-house representation.

Table 1: Variables and number of cases included for 2020 for the sector “Manufacture of batteries and accumulators”.

41 Federal Statistical Office of Germany (2008): Klassifikation der Wirtschaftszweige 2008 (WZ 2008). Published by Federal Statistical Office of Germany. Wiesbaden. Available at: <https://www.destatis.de/static/DE/dokumente/klassifikation-wz-2008-3100100089004.pdf>, accessed: 23.08.2022.

42 See https://statistik.arbeitsagentur.de/DE/Statischer-Content/Grundlagen/Definitionen/Generische-Publikationen/Kurzinformation-Beschaeftigungstatistik.pdf;jsessionid=246EE8C9EEA187654C256A83AC43B909?__blob=publicationFile&v=10 [Accessed on 24.03.2023]

2021	Total			Of which foreign nationals		
	Total	Of which		Total	Of which	
		Men	Women		Men	Women
Total	13,772	10,482	3,290	2,172	1,631	541
Full-time employment	12,451	9,847	2,604	1,961	1,480	481
Part-time employment	1,321	635	686	211	151	60
No vocational qualification	1,425	1,042	383	457	342	115
Recognised vocational qualification	9,165	7,047	2,118	1,056	825	231
Academic qualification	2,754	2,091	663	459	328	131
Qualification unknown	428	302	126	200	136	64
Supervisors	406	363	43	20	17	3
Managers	541	478	63	54	44	10
Under 20 years	166	129	37	4	4	-
20 to under 30 years	2,310	1,757	553	500	386	114
30 to under 40 years	3,951	3,090	861	739	568	171
40 to under 50 years	3,013	2,226	787	536	368	168
50 to under 60 years	3,269	2,443	826	333	255	78
60 years and over	1,063	837	226	60	50	10

Source: Special statistical analysis of the German Federal Employment Agency; in-house representation.

Table 2: Variables and number of cases included for 2021 for the sector “Manufacture of batteries and accumulators”.

The statistics are based on social insurance reporting. This includes all employees (including those in vocational training) that are subject to mandatory sickness or pension insurance or mandatory social insurance according to SGB III.⁴³ This group, selected for the corresponding economic sector, was examined according to the following characteristics (Federal Employment Agency 2022b⁴⁴):

- Gender: male/female
- Nationality: German citizenship/foreign nationals⁴⁵
- Age in categories
- Employment status: full-time/part-time⁴⁶

43 See <https://www.arbeitsagentur.de/betriebsnummern-service/meldeverfahren-sozialversicherung#:~:text=hierzu%20entsprechende%20Hinweise,-,So-fortmeldeverfahren,ist%20dies%20die%20Minijob%2DZentrale> [Accessed on 24.03.2023]

44 Federal Employment Agency (2022b): Meldeverfahren zur Sozialversicherung. Schlüsselverzeichnis für die Angaben zur Tätigkeit, Ausgabe 10. Published by Federal Employment Agency. Nuremberg. Available at: https://www.arbeitsagentur.de/datei/schlüsselverzeichnis-fur-die-angaben-zur-tatigkeit-05-2022_ba147472.pdf, accessed: 13.10.2022.

45 Only citizenship is considered in this study, not the existence of a migration background.

46 In the special analysis, full-time means the normal working time established by collective agreement or by the employer. Part-time means any contractually established working time that is less than the normal working time established by collective agreement or by the employer.

- Type of the highest qualification: no vocational qualification/ completion of a recognised vocational qualification/ academic qualification (includes bachelor, diploma/ master/state examination, doctorate)/ qualification unknown⁴⁷
- Type of leadership function: supervisor⁴⁸/ manager.⁴⁹

The differentiation between supervisors and managers is based on the position according to the occupational classification of the German Federal Statistical Office 2010 (KldB 2010) (Federal Employment Agency 2021⁵⁰).⁵¹ The analyses were performed for 2020 and 2021, respectively with a reporting date of 31 December of each year. Where no significant development is observed between the years, the representations are for 2021.

The following characteristics were also examined:

- Earnings and differences in earnings

This was compared between women and men in the industry. Earnings are reported in the special analysis based on the gross monthly earnings of full-time employees.

What assumptions were made?

The extent to which women, foreign nationals and older employees are under-represented in the sector “Manufacture of batteries and accumulators” was examined in the analyses. Under-represented means that their proportion in the sector under consideration is lower than the corresponding proportion in Germany’s labour market as a whole. This was expected in particular for women, since women are generally found less often in STEM occupations than men (Federal Employment Agency 2022a⁵²). To what extent older people and foreign nationals, who are generally under-represented in the labour market as a whole, are found even less frequently in battery cell manufacturing was an open question that was also analysed.

It was also presumed that women and foreign nationals⁵³, similar to the German labour market as a whole, are more frequently employed in lower occupational positions and (for women in particular) more often work part-time, and that women’s earnings are lower on average than those of men. Research shows that women and people with a migration background are disadvantaged in the labour market, for instance regarding earnings, and that this can only be explained in part by observable characteristics such as education and work experience (Federal Statistical Office of Germany 2022⁵⁴; Keita and Valette 2020⁵⁵).⁵⁶

47 Under “not applicable” in the special analysis.

48 Defined as follows in the special analysis: Supervisors are specialists with a management function. They undertake tasks that require specialised knowledge and skills, for example, in the commercial and business administration field or in the organisational and administrative field. They assume responsibility for planning and organisation, and supervise the employees in their department or section.

49 Defined as follows in the special analysis: Managers are experts with a management function. They undertake tasks with a high degree of complexity. They manage companies and organisations, and assume responsibility for employee recruitment and leadership, targets and quality management, budget planning and resource efficiency.

50 Federal Employment Agency (2021): Klassifikation der Berufe 2010 – überarbeitete Fassung 2020. Band 1: Systematischer und alphabetischer Teil mit Erläuterungen. Published by Federal Employment Agency. Nuremberg. Available at: https://statistik.arbeitsagentur.de/DE/Statischer-Content/Grundlagen/Klassifikationen/Klassifikation-der-Berufe/KldB2010-Fassung2020/Printausgabe-KldB-2010-Fassung2020/Generische-Publikationen/KldB2010-PDF-Version-Band1-Fassung2020.pdf?__blob=publicationFile&v=19, accessed: 23.08.2022.

51 All activities with the coding XXX93 are summarised for supervisors (specialists with a management function). For managers (experts with a management function), all activities with the coding XXX94 are summarised (plus selected experts who are not coded with the numeral 9 in the 4th place).

52 Federal Employment Agency (2022a): Reports: Blickpunkt Arbeitsmarkt – Die Arbeitsmarktsituation von Frauen und Männern. Federal Employment Agency. Nuremberg. Available at: https://statistik.arbeitsagentur.de/DE/Statischer-Content/Statistiken/Themen-im-Fokus/Frauen-und-Maenner/generische-Publikationen/Frauen-Maenner-Arbeitsmarkt.pdf?__blob=publicationFile, accessed: 28.09.2022.

53 Age is excluded here since it is too highly correlated with work experience and seniority, and because multivariate analyses are not possible here.

54 Federal Statistical Office of Germany (2022): Gender Pay Gap 2021: Frauen verdienen pro Stunde weiterhin 18 % weniger als Männer. Pressemitteilung Nr. 088 vom 7. März 2022. Published by Federal Statistical Office of Germany. Wiesbaden. Available at: https://www.destatis.de/DE/Presse/Pressemitteilungen/2022/03/PD22_088_621.html, last update: 07.03.2022, accessed: 10.08.2022.

55 Keita, Sekou; Valette, Jérôme (2020): Arbeitsmarktdiskriminierung: Zugewanderte, denen man weniger vertraut, bleiben länger arbeitslos. In: IAB-Kurzbericht (10/2020), p. 1–8. Available at: <https://doku.iab.de/kurzber/2020/kb1020.pdf>, accessed: 16.11.2022.

56 For people with a migration background, this apparently applies only for immigrants from countries considered less trustworthy; see Keita and Valette 2020.

Education and training differences between women and men were only suspected to a lesser extent in this economic sector, since the education and training of women and men in Germany is becoming increasingly similar in general. The extent of education and training inequality between Germans and foreign nationals was examined as well. Increasing polarisation in the educational level of immigrants can be observed in recent years, with numerous highly qualified people but also many with no formal educational qualifications (Baas 2021⁵⁷).

What was analysed?

Figures for the proportion of women, older people and foreign nationals in general and (only for women and foreign nationals) according to the type of employment, level of education and training as well as occupational position in the sector “Manufacture of batteries and accumulators” were presented in the analyses. Where possible, these figures were compared with those for the German labour market as a whole in order to estimate the extent of diversity and specific challenges in battery cell manufacturing. Intersectional examinations were performed as well, that is, comparisons between women and men within the group of foreign nationals, in order to find out to what extent the existence of two diversity dimensions intensifies inequalities.

The gender pay gap was calculated as the difference between the average earnings of men and women in proportion to the average earnings of men.

Limitation

In view of the study orientation, three key dimensions of diversity, “nationality”, “gender” and, with restrictions, “age” (in categories) were analysed (Charta der Vielfalt e.V. 2022⁵⁸). Other dimensions such as religion can however be examined in the analyses as well in subsequent research studies if needed (see the key dimensions of diversity in Figure 16). Gender information is only available for “male” and “female” in the data, not for “diverse”. Nationalities were not examined individually because the number of cases is too small. All foreign nationals were combined into one group. The migration background is not available in the data. Presenting an industry comparison across all phases of the value chain is not possible either because the number of cases in the individual industries is too small.

The unadjusted gender pay gap was presented, meaning that observable characteristics such as qualifications, work experience etc. were not statistically controlled for. The gender pay gap adjusted for these factors in battery cell production cannot be presented in this study, and should be analysed in subsequent research studies.

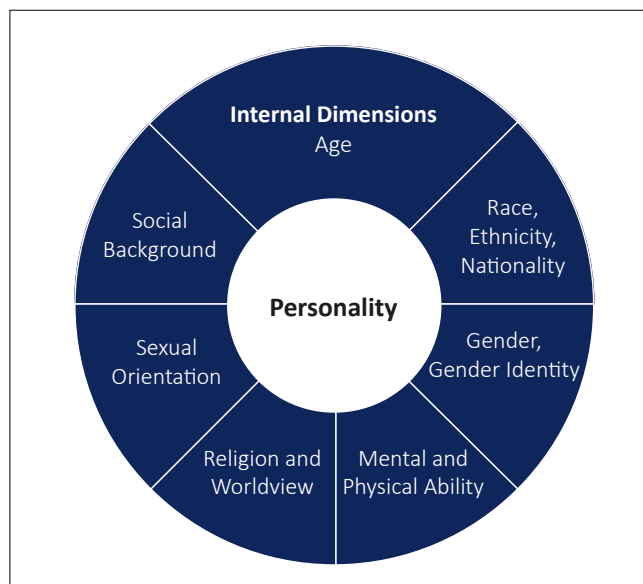


Figure 16: Internal dimension of diversity based on Gardenswartz and Rowe (Diverse Teams at Work (2nd Edition, SHRM, 2003)), in-house representation.

57 Baas, Meike (2021): Bildungsbeteiligung nach Migrationshintergrund. In: WISTA (2/2021). Available at: https://www.destatis.de/DE/Methoden/WISTA-Wirtschaft-und-Statistik/2021/02/bildungsbeteiligung-022021.pdf?__blob=publicationFile, accessed: 29.11.2022.

58 Charta der Vielfalt e.V. (2022): Factbook Diversity. Published by Charta der Vielfalt e.V. Berlin. Available at: https://www.charta-der-vielfalt.de/fileadmin/user_upload/Diversity-Tag/2022/Deutscher_Diversity-Tag_2022/Factbook_2022.pdf, accessed: 15.08.2022.



3.2 Demand for versus shortage of skilled workers – insights into the demand for skilled workers over the next ten years



Key findings

The demand for skilled workers in battery cell manufacturing will increase sharply in the next ten years. With regard to personnel directly involved in production, the demand for skilled occupations in the STEM fields is particularly high. Shortages are expected here for the occupational profiles of mechanics and laboratory/chemical technicians. The current proportion of women and foreign nationals in the sector “Manufacture of batteries and accumulators” is higher than the proportion that would be expected from the respective skilled occupations. Thus conditions in this economic sector appear to be favourable for a successful implementation of diversity measures.

3.2.1 The demand for skilled talents

Battery cell manufacturing in Germany and Europe is growing rapidly and thus the demand for skilled workers is steadily increasing. At the same time, scaling effects and production effectiveness accompanying the increase in production capacities will naturally lead to a decrease in the number of skilled workers required per production unit (Thielmann et al. 2021⁵⁹).

By unifying the above mentioned two trends, the demand for skilled workers in three steps of the battery value chain (upstream, battery production and battery cell production) can be estimated and predicted, respectively. An estimate for Europe until 2035 is presented in Figure 17. The far greater personnel requirements in upstream processes (material and component manufacturing) compared to battery cell manufacturing are clearly evident.

A maximum demand for skilled workers around the year 2033 is also evident in Figure 17. This results in a projected demand for skilled workers in Europe until 2035 totalling (min./max.) 232,000/348,000, 46,000/70,000 and 31,000/46,000 in upstream, battery production and battery cell production, respectively. Thus, between 1,000 and 5,000

additional skilled talents will be needed annually until 2033, just in battery cell production.

The focus will be on Germany in the following. Figures were scaled down by a factor of 0.38 from the European values for this purpose (in 2030, battery cell production capacity Europe ~1,300 GWh and Germany ~494 GWh (Heimes 2022⁶⁰)). Furthermore, the following descriptions will focus on battery cell production (green bars in Figure 17) or, more precisely, on the production staff (departments such as R&D, Administration, HR etc. are initially excluded from the examination). Based on the analysis of job advertisements, interviews and published studies a ratio of fitters/setters to laboratory and other technicians to production workers of 6:30:10 was defined. This results in a modelled composition of production staff as shown in Figure 18. Six job roles were defined and their distribution is as follows: Production workers (17%), laboratory and other technicians (61%), fitters/setters (11%), shift supervisors (6%), engineers/scientists (4%) and management (<1%). This reflects the high demand for production staff with relevant vocational training (laboratory and other technicians, fitters/setters, shift supervisors) with a total of 78%. These are mostly trained skilled workers in the fields of mechanics, mechatronics, electronics, automation and, with regard to

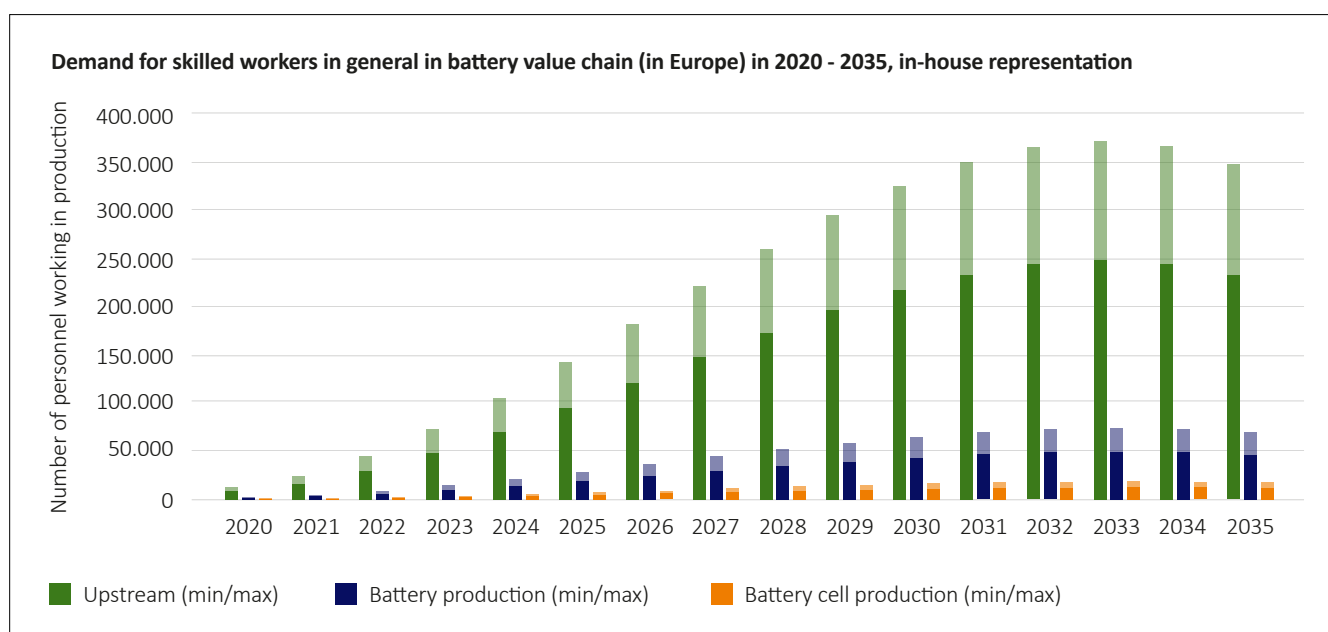


Figure 17: Demand for skilled workers in general in battery value chain (in Europe) in 2020-2035, in-house representation. The respective min./max. values are presented. The proportions of the different areas (upstream, battery production and battery cell production) were taken from the Fraunhofer study (Thielmann et al. 2021).

59 Thielmann, Axel; Neef, Christoph; Hettesheimer, Tim; Ahlbrecht, Katharina; Ebert, Sandra (2021): Future Expert Needs in the Battery Sector. Published by EIT RawMaterials GmbH. Berlin. Available at: <https://eitrawmaterials.eu/wp-content/uploads/2021/03/EIT-RawMaterials-Fraunhofer-Report-Battery-Expert-Needs-March-2021.pdf>, accessed: 14.10.2022.

60 Heimes, Heiner (Publisher) (2022): Battery Atlas 2022. Shaping the European Lithium-Ion Battery Industry, 1st edition. Aachen: (PEM) | RWTH Aachen University.

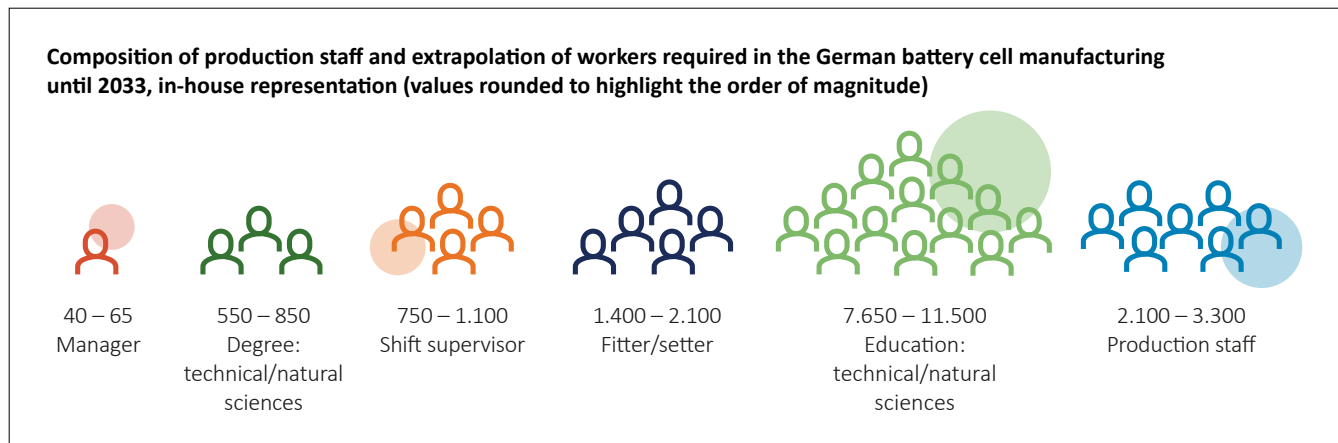


Figure 18: Composition of production staff in cell manufacturing, in-house representation. Extrapolation of workers required in Germany in the various battery cell manufacturing job roles until 2033 (values rounded to highlight the order of magnitude).

active material production, quality and health/environment/safety, also chemicals and materials. Fitters/setters (around 11% of the production staff) have a technical education and extensive knowledge and experience in the handling, setup and optimisation of machines. Shift supervisors as well have a technical education and are responsible for the organisation of workflows in their shift and the implementation of production specifications. Semi-skilled production workers are the second-largest single group with 17% and represent a smaller proportion; trainees are included here.

Qualitative and quantitative composition of production staff

The qualitative and quantitative composition of the production staff is examined below. The demand in seven training and eight study fields (National Platform Future of Mobility 2021⁶¹) was investigated in more detail for this purpose, with the addition of laboratory/chemical technician since the demand for this qualification is particularly high in active material production, quality and health/environment/safety as well as recycling. Table 3 summarises the distribution of the aforementioned qualifications extracted from the job profiles assigned to the respective departments.

For line staff, active material production has the highest demand for a wide variety of qualifications, while more uniform job profiles (mechanics) are needed in cell manufacturing and downstream. A reason for this is the direct handling of materials (powders, pastes...) and different battery components, whereas in cell manufacturing the work is more focussed on the machine itself less on materials. This results in requirement profiles ranging from

the technical (mechanics, mechatronics...), mainly needed in cell manufacturing and downstream, to the material-based field (chemistry...). The demand for a number of different disciplines in production/process technology is especially high in the production support departments. These include the various specialisations of mechanics (plants, production, industrial, ...), mechatronics (automation...) and electronics. Skilled talents with knowledge in fields such as environmental, material, chemistry and electronics are also found in the requirement profiles for the departments health/environment/safety and quality.

A comprehensible picture emerges as well when looking at the data for skilled workers with academic degrees required for tasks of higher complexity and/or with greater responsibility. Engineers specialised in mechanical engineering, electronics, mechatronics and process technology are mainly needed in production/process technology. Skilled workers with academic degrees in the fields of chemistry, material sciences, process technology and environmental studies are of particular interest for the quality and health/environment/safety departments.

Quantitative estimates based on the data in Table 3 and Figure 18 are presented in Figure 19. Accordingly, for skilled workers with a skilled occupation, the entire demand for mechanics (with various specialisations) is highest at 7,000 to 10,500 (around 550 to 800 per year) and thus, approximately one order of magnitude higher compared to the required number of laboratory/chemical technicians, electronics engineers and mechatronics engineers, respectively. The demand distribution is more homogeneous for skilled workers with academic degrees. Holders of academic

61 National Platform Future of Mobility (2021): Neue Impulse für Beschäftigung und Qualifizierung im Mobilitätssektor. Bericht der Fokusgruppe Strategische Personalplanung und-entwicklung der AG 4. Published by Federal Ministry for Digital and Transport (BMVI). Available at: https://www.plattform-zukunft-mobilitaet.de/wp-content/uploads/2021/10/NPM_AG4_Beschaeftigung.pdf, accessed: 14.10.2022.

Summary of skilled workers needed in Germany for the production staff and R&D in battery cell manufacturing between 2020 and 2033; in-house representation.

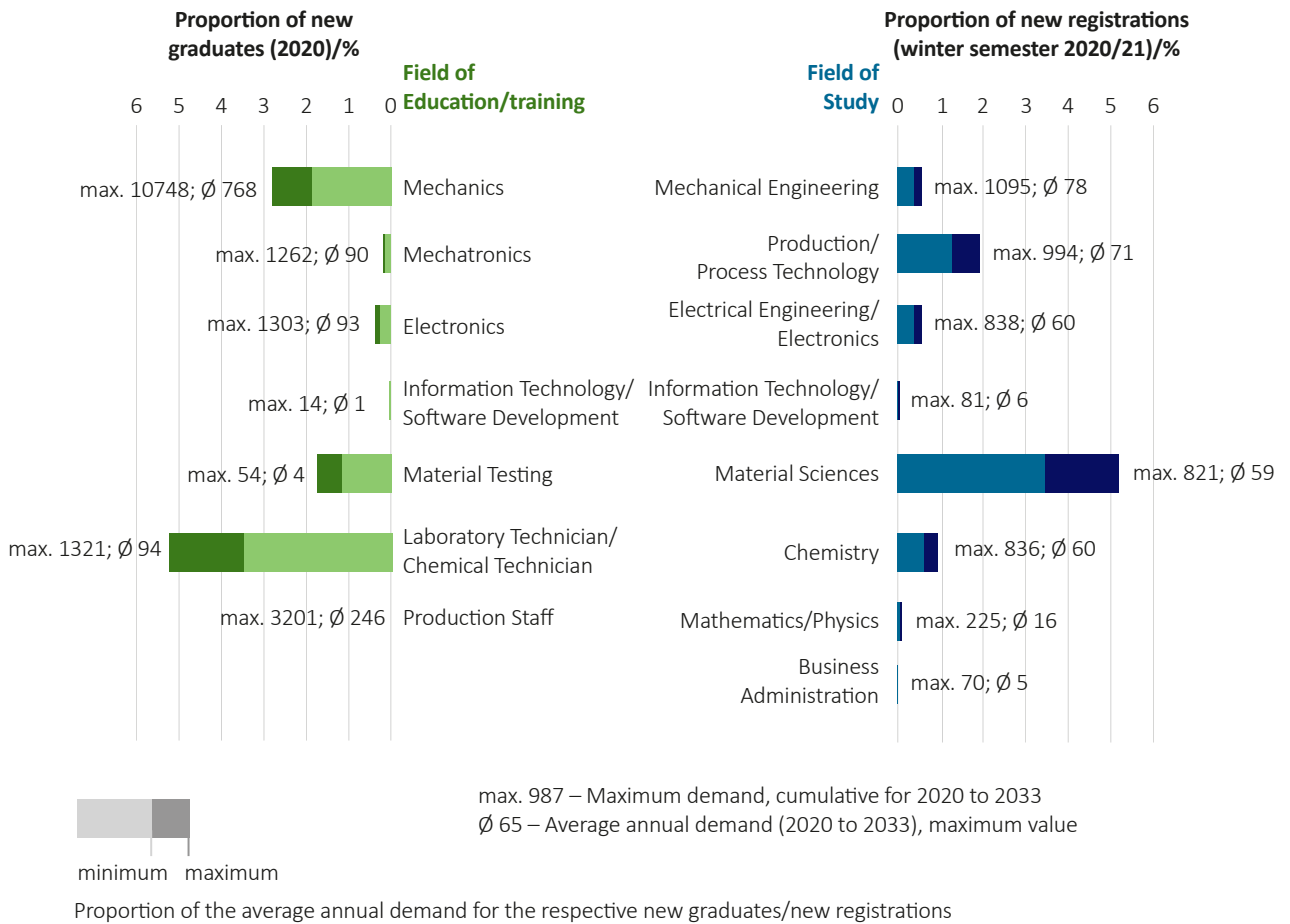


Figure 19: Summary of skilled workers needed in Germany for the production staff and R&D in battery cell manufacturing between 2020 and 2033; in-house representation. The skilled occupations are shown on the left and the academic occupations on the right. Their maximum (max.) and average annual (Ø) demands are given as numeric values. The proportion of the average annual demand (Ø) out of the respective new registered for vocational training (in 2020) and new registrations for academic studies (in the 2020/21 winter semester), respectively, are visualised as bars for the minimum (light) and maximum (dark) demand.

degrees in the disciplines of mechanical engineering and production/process technology are estimated with the highest demand around 130 to 260 skilled workers annually, followed by skilled workers in electrical engineering/electronics, material sciences and chemistry, respectively, with figures of around 50 to 100 per year.

The high annual demand for skilled workers in mechanics stands out of the skilled occupations in Figure 19. This would make up around two to three per cent of the new graduates in Germany. In the scientific skilled occupations (chemical/laboratory technician), the annual demand is actually somewhat higher at 3.7% to 5.6%. The occupational profile of material tester is as well in high demand projected with a significant proportion of 1.2% to 1.9% of the new registered vocational training in the field. In the remaining required technical occupations like mechatronics and electronics, the

proportion of annual demand compared to new registered in vocational training is in the low percentage range (0.14% to 0.4%). For the academic occupations, demand relative to new registrations is highest in the disciplines of production/process technology (at 1.3% to 1.9%) and material sciences (at 4.5% to 5.2%). Skilled workers with academic degrees are mainly found in departments for research and development. Here the demand for skilled workers in mechanical engineering and production/process technology is about three times higher compared to production departments, and for disciplines of electrical engineering/electronics these figures can be as high as ten times. There are around six to seven times as many skilled workers in material sciences and chemistry in the R&D department compared to the production staff assumed here. See Figure 19 for a diagram summarising these figures.

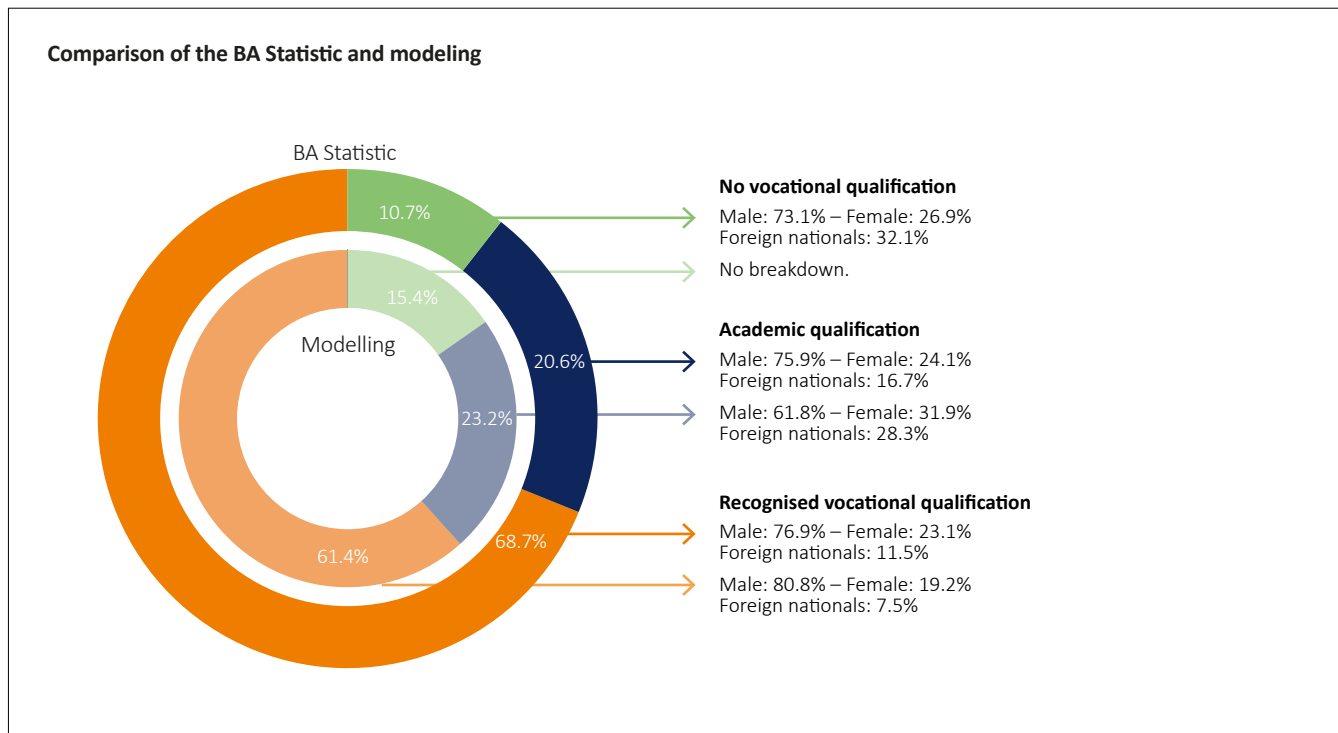


Figure 20: Comparison of the data from the statistics of the German Federal Employment Agency for the Economic Activity 272 “Manufacture of batteries and accumulators” (outer circle diagram, the item 3.1% “not applicable” was excluded from the examination) and the data from this study modelled on this basis (inner circle diagram); in-house representation.

Comparing modelled data and employment statistics

The modelled composition of the production staff and further assumptions (as in Section 2.2) were compared with the data collected by the German Federal Employment Agency. Figure 20 presents the results as percentage shares for easier comparison. The following can be observed: Firstly, the assumptions made above reflect the actual proportions of skilled workers in the three categories relatively well (without occupation, recognised training qualification and academic occupation).

Overall the assumed proportion of employees with recognised occupations was too low and that for academic occupations was too high. The proportion of employees with no training qualification (including trainees and semi-skilled production workers) was much higher in the model than in the statistics of the German Federal Employment Agency. Since the proportion of trainees is assumed to be consistent, this means fewer semi-skilled production workers have to work in this economic sector than assumed in the model. The ratio of fitters/setters to laboratory and other technicians to production workers would change from 2:10:3 to 2:12:3, towards a higher proportion of skilled workers with a recognised training qualification. Another point that stands out for skilled workers with a recognised training qualification is that the proportion of women and foreign nationals is higher

than the figures reported for the respective proportions of those who are currently in vocational training. Since this educational group (with a recognised training qualification) is proportionately larger, a positive conclusion can be drawn here regarding the existing diversity in these two dimensions (i.e. women and foreign nationals). Conditions therefore appear to be favourable for further developing these diversity dimensions. The assumed proportion of academic occupations was overall predicted slightly too high (23.2% to 20.6%). The proportions of women and foreign nationals in academic occupations were lower than expected based on the student statistics. Based on efforts of HR departments to recruit skilled workers with academic qualifications on the international labour market, it is presumed that the proportions of women and foreign nationals in academic occupations will increase in the future.

3.2.2 Methodology and approach for modelling the demand for skilled workers

How were the data recorded and prepared?

The composition of production staff was emulated to quantify the demand for skilled workers in specific occupational groups in battery cell manufacturing. Figure 21 depicts the recording and preparation of the data. Publicly accessible job advertisements were collected (using the Northvolt Ett⁶² plant in Sweden as an example, since these advertisements provided a high level of detail). The job roles and qualifications described therein were collected and assigned to the branches of study (mechanical engineering, production/process technology, electrical engineering/electronics, information technology/software development, material sciences, chemistry, mathematics/physics and business administration)

and skilled occupations (mechanic, electronics engineer, IT specialist/software developer, material inspector, business administration graduate and laboratory/chemical technician) with special relevance for battery cell production (National Platform Future of Mobility 2021⁶³). Table 3 shows a result of the job advertisement analysis. The analysed qualifications were divided into skilled occupations and academic occupations, and assigned to the respective departments. When multiple qualifications were mentioned in one job profile, they were accounted for individually. An example for explanation, the active material department: Qualifications in mechanics, mechatronics, electronics and natural sciences were required in the corresponding advertised positions for skilled occupations. The frequency of naming these qualifications in the relevant advertisements was 40% for mechanics and each 20% for mechatronics, electronics and natural sciences, respectively.

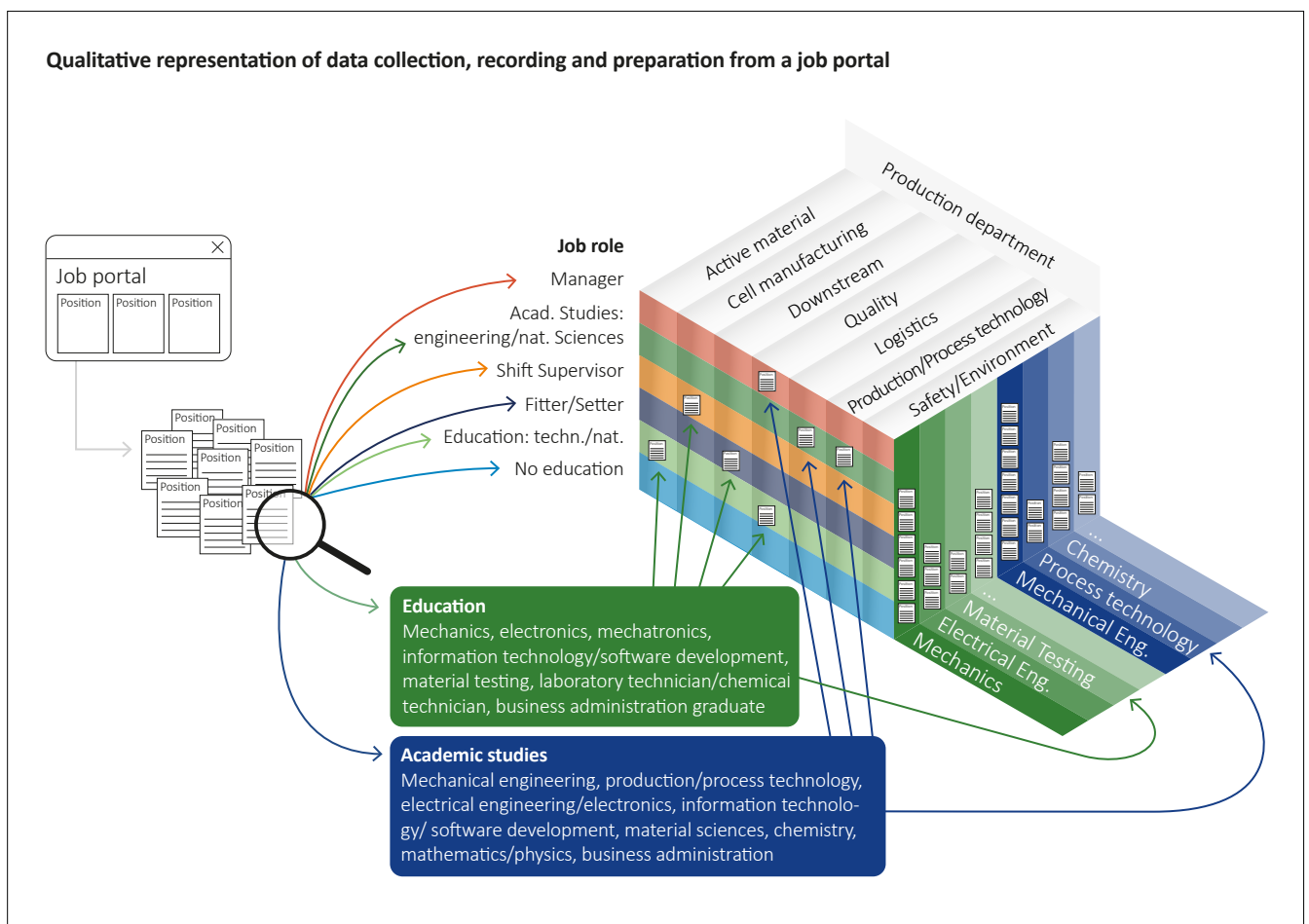


Figure 21: Qualitative representation of data collection, recording and preparation. Jobs from the Northvolt job portal for the Northvolt Ett plant were analysed by job roles, skilled occupations and academic occupations, and assigned to the corresponding production departments; in-house representation.

⁶² Job advertisements accessed at <https://northvolt.com/career/roles/?d=Production%2CQuality+%26+HSE&l=Skellefte%C3%A5> [Accessed on 9.06.2022]

⁶³ National Platform Future of Mobility (2021): Neue Impulse für Beschäftigung und Qualifizierung im Mobilitätssektor. Bericht der Fokusgruppe Strategische Personalplanung und-entwicklung der AG 4. Published by Federal Ministry for Digital and Transport (BMVI). Available at: https://www.plattform-zukunft-mobilitaet.de/wp-content/uploads/2021/10/NPM_AG4_Beschaeftigung.pdf, accessed: 14.10.2022.

Production departments → Academic occupations ↓	Active material	Cell manufacturing	Down-stream	Production/production technology	Environment & safety	Quality	Logistics
Mechanical engineering	50%	50%	100%	35%	25%	7%	20%
Production engineering/ process technology	50%	50%		29%	38%	36%	
Electrical engineering/ electronics				21%			
Information technology/ software development				12%			
Materials						29%	
Chemistry					38%	21%	
Mathematics/physics						7%	
Business administration							80%
Skilled occupations ↓							
Mechanic	40%	100%	100%	68%		14%	100%
Electronics engineer	20%			16%		14%	
Mechatronics engineer	20%			14%			
IT specialist/ software developer				3%			
Material tester						29%	
Business administration graduate							
Laboratory/ chemical technician	20%				100%	43%	

Table 3: Quantitative description of the recorded and prepared data from Figure 21. Listing of the proportion of naming of academic and skilled occupations in job advertisements for the respective production departments.

What assumptions were made?

The increase in Europe's battery cell manufacturing capacity was assumed for 2020 (25 GWh), 2025 (380 GWh) and 2030 (1300 GWh) (Heimes 2022) and represented by a function with a second-degree polynomial. The required number of skilled workers per GWh of battery production decreases in the same period, from minimum/maximum 400/600 (2020) to 300/450 (2025) to 200/300 (2030) (Thielmann et al. 2021⁶⁴). Thus, there is a linear relationship with respect

to time. Both mathematical representations are shown in Figure 22.

These data represent the demand for skilled workers in the battery value chain as a whole. It was divided into various stages, the ratios of which were assumed as follows: The ratio of workforce demand in the upstream stage to the battery production is approximately 5:1, in which the latter can be broken down into battery cell manufacturing and battery module/pack manufacturing plus indirect jobs with

64 Thielmann, Axel; Neef, Christoph; Hettesheimer, Tim; Ahlbrecht, Katharina; Ebert, Sandra (2021): Future Expert Needs in the Battery Sector. Published by EIT RawMaterials GmbH, Berlin. Available at: <https://eitrawmaterials.eu/wp-content/uploads/2021/03/EIT-RawMaterials-Fraunhofer-Report-Battery-Expert-Needs-March-2021.pdf>, accessed: 14.10.2022.

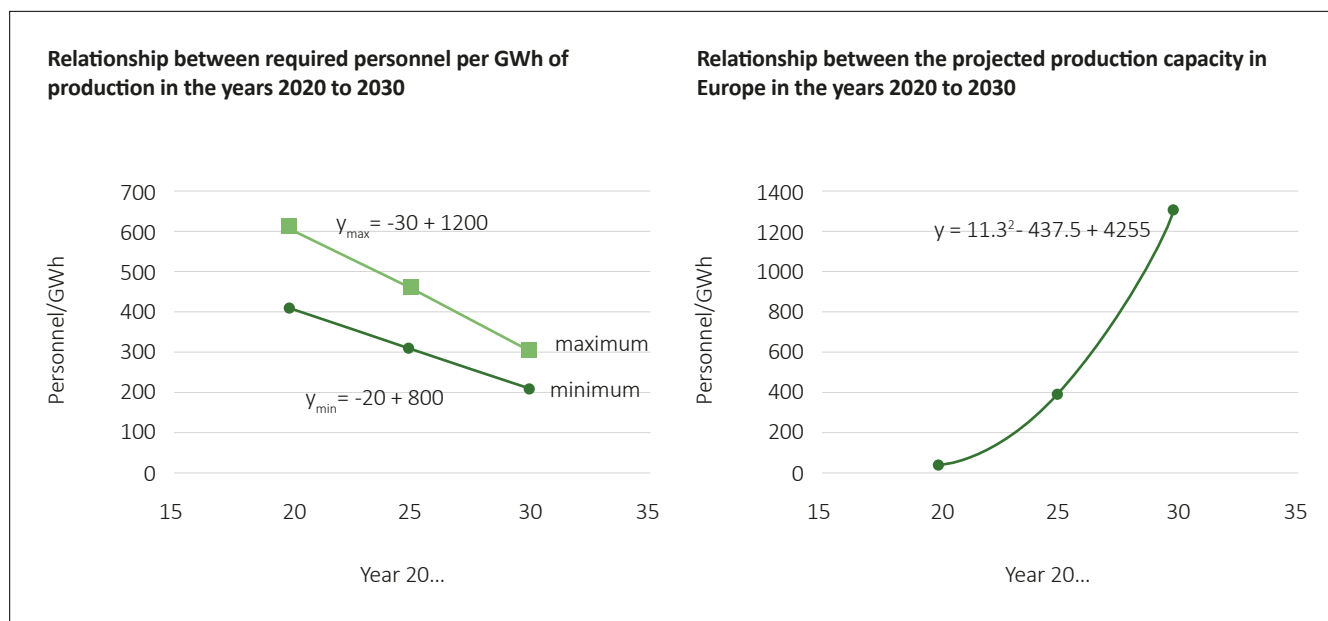


Figure 22: (Left) Relationship between required personnel, maximum (red marking) and minimum (blue marking) per GWh of production in the years 2020 to 2030 (Thielmann et al. 2021). The data can be described with a linear function. (Right) Relationship between the projected production capacity in Europe in the years 2020 to 2030 (Heimes 2022). These data can be described with a second-degree polynomial.

a ratio of 2:1 (Thielmann et al. 2021⁶⁵). The active material production, cell building, downstream, process technology, safety/environment, quality and logistics departments were considered to be directly involved in production. Their shares of the production staff were assumed to be 39%, 34%, 17% and 10% all together for the latter four departments (Thielmann et al. 2021⁶⁶). This is visualised in Figure 23. Since the announced production capacity in Germany for 2030 is assumed to reach around 494 GWh (Heimes 2022⁶⁷), the analysed data for the demand of skilled workers was scaled down to present figures for Germany.

Based on discussions with experts in the battery value chain, the composition of staff in a production line was also projected, notably the ratio of fitters/setters to laboratory and other technicians to production workers (semi-skilled). Two extreme values were assumed for this ratio, (a) 6:30:10 (shown in Figure 23) and (b) 6:20:40. A ratio of engineers/scientists

to technicians of two to one in the quality department and one to two in process technology was also assumed. Shift supervisors and fitters/setters were assumed to be in scientific/skilled occupations.

Further modelling assumptions are shown in Figure 24 and explained here. The overall staff distribution was assumed with 15% in administration, 15% in R&D and 70% in production, respectively (Nationale Plattform Elektromobilität (NPE) 2016⁶⁸). The composition of the administration department regarding academic and skilled occupations was set to be one to two (own estimate). The proportion of women in these departments was assumed to be 46.6% for academic occupations (based on student statistics for economics⁶⁹) and 70% for skilled occupations (average for the occupational groups of law/administration and economics/office⁷⁰). The percentage of employees with no recognised training qualification that also include trainees,

65 Thielmann, Axel; Neef, Christoph; Hettesheimer, Tim; Ahlbrecht, Katharina; Ebert, Sandra (2021): Future Expert Needs in the Battery Sector. Published by EIT RawMaterials GmbH. Berlin. Available at: <https://eitrawmaterials.eu/wp-content/uploads/2021/03/EIT-RawMaterials-Fraunhofer-Report-Battery-Expert-Needs-March-2021.pdf>, accessed: 14.10.2022.

66 Thielmann, Axel; Neef, Christoph; Hettesheimer, Tim; Ahlbrecht, Katharina; Ebert, Sandra (2021): Future Expert Needs in the Battery Sector. Published by EIT RawMaterials GmbH. Berlin. Available at: <https://eitrawmaterials.eu/wp-content/uploads/2021/03/EIT-RawMaterials-Fraunhofer-Report-Battery-Expert-Needs-March-2021.pdf>, accessed: 14.10.2022.

67 Heimes, Heiner (Publisher) (2022): Battery Atlas 2022. Shaping the European Lithium-Ion Battery Industry, 1st edition. Aachen: (PEM) | RWTH Aachen University.

68 Nationale Plattform Elektromobilität (NPE) (2016): Roadmap integrierte Zell- und Batterieproduktion Deutschland. Published by Gemeinsame Geschäftsstelle Elektromobilität. Berlin. Available at: https://www.plattform-zukunft-mobilitaet.de/wp-content/uploads/2021/12/2016_Roadmap_integrierte_Zell-_und_Batterieproduktion_Deutschland.pdf, accessed: 17.10.2022.

69 See <https://www-genesis.destatis.de/genesis/online?operation=ergebnistabelleUmfang&levelindex=1&levelid=1666073935117&download-name=21311-0003#abreadcrumb> [Accessed on 14.10.2022]

70 See <https://de.statista.com/statistik/daten/studie/167555/umfrage/frauenanteil-in-verschiedenen-berufsgruppen-in-deutschland/> [Accessed on 14.10.2022]

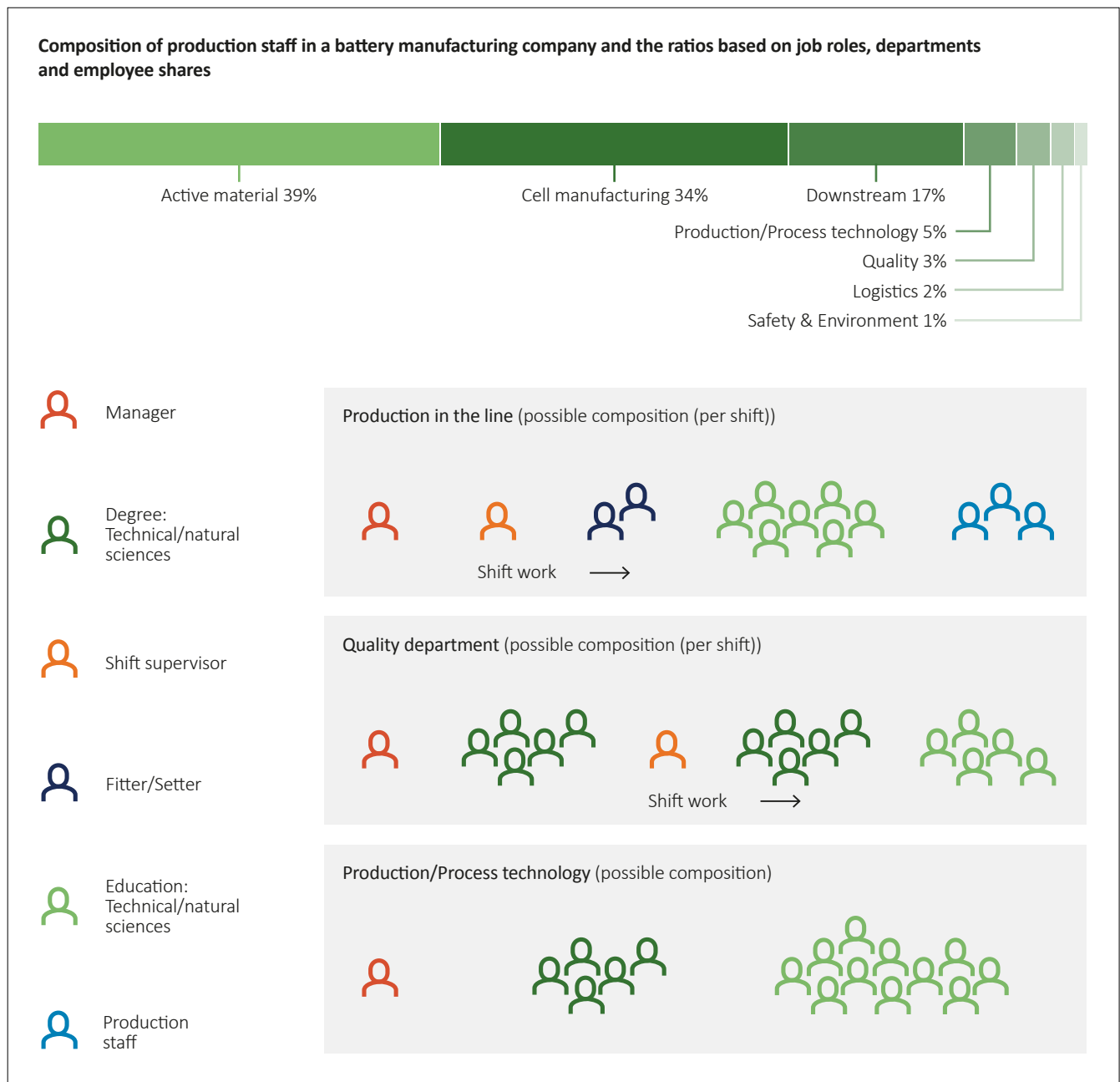


Figure 23: Composition of production staff in a battery manufacturing company; in-house representation. (Left) The symbols respectively represent a job role, which is broken down into academic occupations and skilled occupations or no professional qualification. (Right) The ratios of the number of different job roles (in and outside shift work) in three production departments (production in the line, quality and production/process technology) are shown. Manager merely refers to a person as department manager here (more detailed structuring would involve excessive speculation). Thus a direct quantitative relation to the remaining job roles in the respective department cannot be drawn from this. (Above) This describes the proportion of employees in the departments examined in this study (directly involved in production, i.e. excluding R&D, administration etc.) in comparison to the total number of employees in all of these departments together.

was represented in the model with 4.8% (this is an average of the figures in the fields of chemistry/pharmaceuticals, metal/electrical and other goods (paper, wood...) from the BIBB statistics)⁷¹. Trainees were assumed to be in adminis-

tration and production (not R&D). Other employees with no training qualification were assigned solely to production. The proportion of women in skilled occupations⁷² and fields of study⁷³ was taken from statistics. The figures

71 See https://www.bibb.de/dokumente/pdf/a2_tab_a7_1-10_Internet_2021.pdf [Accessed on 24.03.2023]

72 See https://www.bibb.de/dokumente/xls/dazubi_berufsliste-mint_2020.xlsx [Accessed on 24.03.2023]

73 See https://www.destatis.de/DE/Themen/Gesellschaft-Umwelt/Bildung-Forschung-Kultur/Hochschulen/_inhalt.html;jsessionid=DC2F5C91052D64B-63D1A287F3044F5D6.live742 [Accessed on 24.03.2023]

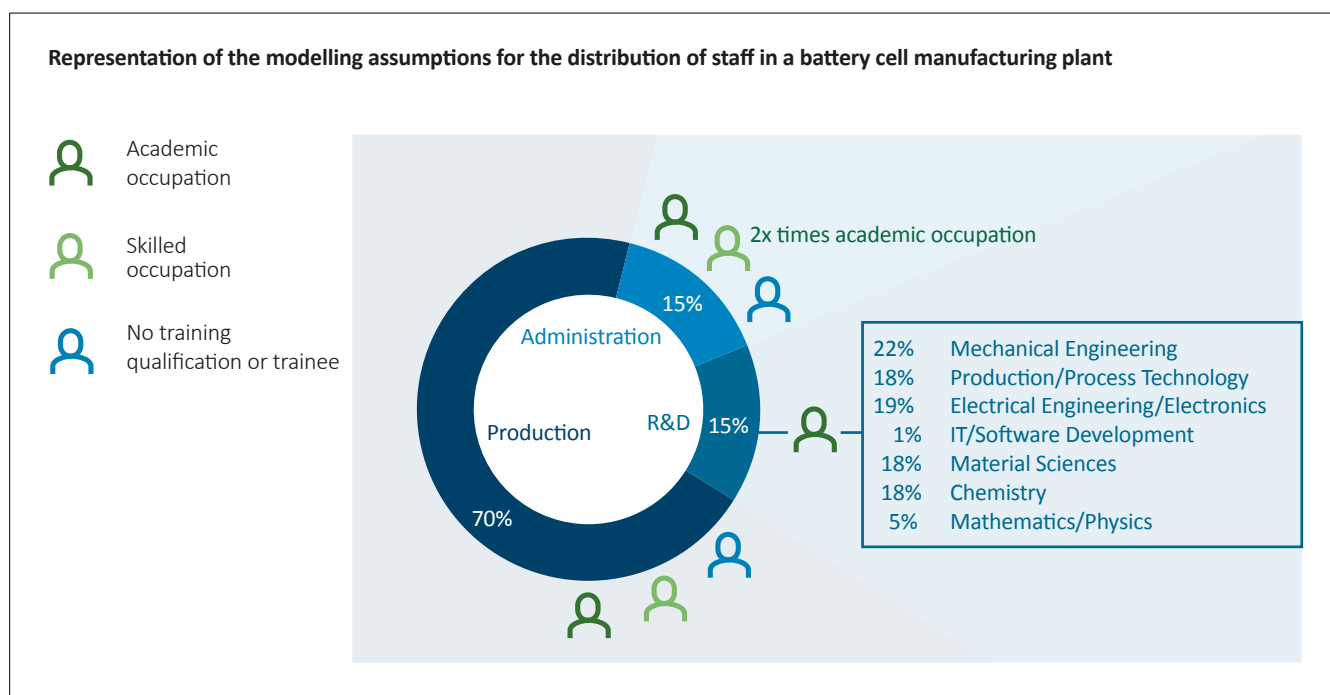


Figure 24: In-house representation of the modelling assumptions. The distribution of staff in an average battery cell manufacturing plant was assumed with 15% in administration, 15% in R&D and 70% in production. Academic occupations (green figures) were assumed in all three categories, skilled occupations, semi-skilled workers and trainees (blue figures) in the administration and production departments. The trainee proportion of 4.8% was assumed in the respective departments (administration and production) in reference to the total number of employees in the respective department. An assumed composition of the R&D department by academic occupations was described in percentages. In the administration department, the ratio of employees with academic occupations to skilled occupations was assumed to be one to two. See the text for references.

for the composition of R&D departments were as well retrieved from job advertisements (mainly from North-volt) and assigned to fields of study as follows: Mechanical engineering (22%), production/process technology (18%), electrical engineering/electronics (19%), information technology/software development (1%), material sciences (18%), chemistry (18%), mathematics/physics (5%). The resulting proportions of women, men and foreign nationals were derived by the model based on the proportions of these parameters in the statistic figures of skilled occupations and fields of study, their statistics in 2020 and the 2021/2022 winter semester, respectively.

What was analysed?

The figures for the projected production capacity and skilled workers per GWh of production described above result in a cumulative number of skilled workers required in a particular year. These figures were then distributed among departments and job roles based on the aforementioned assumptions (see Figure 23).

The composition of the individual departments regarding included job roles (see Figure 21 and Figure 23) results in figures for employees in academic occupations and skilled occupations. These were then multiplied by the propor-

tions of the individual disciplines, shown in Table 3, thus a projected demand could be determined for each skilled occupation and academic occupation.

The figures obtained in this manner were then compared with the current figures for new registrations in vocational training disciplines and academic disciplines, respectively, to see these numbers in perspective. Furthermore, the modelled employee composition was compared with the statistical data of the German Federal Employment Agency (Section 3.1) regarding the relative distribution of employees with no recognised training qualification, a recognised skilled occupation and academic occupation, and (for the two latter categories) as well the proportions of foreign nationals, women and men.

Limitation

The results are only as plausible as are the assumptions of the data feeding the modelling. Assumptions were taken from the existing literature where possible. For some data own estimations had to be made, based on most reasonable assumptions. To ensure the highest possible degree of plausibility, the assumptions were discussed with a number of experts in the battery sector.



3.3 Insights into diversity and diversity measures of battery cell manufacturing companies in Germany



Key findings

The results of our online survey clearly showed that binding measures for the promotion of diversity in companies contribute to a more diverse workforce. The majority of battery cell manufacturing companies that took part in the survey had no diversity measures in place. However, quite often commitments by the company management existed to promote diversity. The proportion of women and the age diversity among the employees were also comparatively high in companies where such commitments existed. On the other hand, no difference in the proportion of women in the workforce was observed between the surveyed companies with and without a formulated (less binding) mission statement for the promotion of diversity.

3.3.1 Survey results for diversity and diversity measures in companies

The online survey was specifically designed to determine the extent of employee diversity and the existence of measures to build awareness and promote diversity in battery cell production companies. The results are presented below. The number of responses in some of the examined categories appeared rather small. Therefore, the results have to be interpreted with great caution.

Status quo of employee diversity in the surveyed companies

In the companies in the battery value chain that were surveyed, the average proportion of women was about 27% and the proportion of foreign nationals was about 24% (Table 4). However, the median of 14% indicated a considerably lower proportion of foreign nationals in the surveyed companies. The figures were very widely scattered showing statistical outliers, which was observed in a high standard deviation. Thus the median (the value in the centre of the ordered series of values) was the more robust value to look at. The medians approximately corresponded to the distributions of the proportions of women and foreign nationals in the analyses in Section 3.1.1. The examined age diversity value is represented by the standard deviation from the average of proportions in the individual age categories. The values of this standard deviation range between the possible minimum and maximum values of 0% (high age diversity) and 37% (low age diversity), respectively. It was observed that the age diversity was reasonably high with a mean of 15% and a median of 14%.

Implementation of diversity measures in the surveyed companies – prevalence and effectiveness

The observations show that two different effects could clearly be distinguished, depending on the level of commitment behind the diversity measure. Measures to build awareness and to promote diversity with a higher degree of accountability (such as a commitment to the promotion of diversity) and/or measures that may have a greater impact on the externally perceived image of the company (such as diversity-aware wording of job advertisements and evaluations of diversity aspects). Furthermore, such measures appeared more prevalent than measures that increase the awareness of diversity. However these measures have no intention of immediate consequences (such as evaluations of the current state) (Figure 25). According to the online survey, nearly 41% of the companies had an actual commitment to the promotion of diversity by the company management and nearly 37% regularly analysed diversity aspects. The diversity-aware wording and presentation of job advertisements beyond legal requirements was the leading measure. The remaining measures were less prevalent. For example, only 27% of the surveyed companies stated that they were engaged in diversity management. Just over 32% of the surveyed companies had a mission statement for the promotion of diversity and/or regularly conduct employee surveys to determine whether employee diversity is recognised and valued.

Variable	Mean	Median	Standard deviation	Min.	Max.	Number of cases N
Proportion of women	27 %	27 %	± 15 %	0 %	82 %	54
Proportion of foreign nationals	24 %	14 %	± 26 %	0 %	100 %	44
Age diversity ⁷⁴	15 %	14 %	± 7 %	5 %	37 %	50

Source: Online survey 2022, VDI-VDE-IT.

Table 4: Proportion of women, foreign nationals, and age diversity (as described above, represented by the standard deviation of the average proportion for the six age categories examined in this study) in the surveyed companies in 2022.

74 The diversity of the age structure is represented by the standard deviation of the mean of the proportions in the age categories (<20 years, 21-30 years, 31-40 years, 41-50 years, 51-60 years, > 60 years). A lower standard deviation means a more even distribution of the employees across the age categories (high age diversity), while a higher standard deviation means a more uneven distribution of the employees across the age categories (lower age diversity).

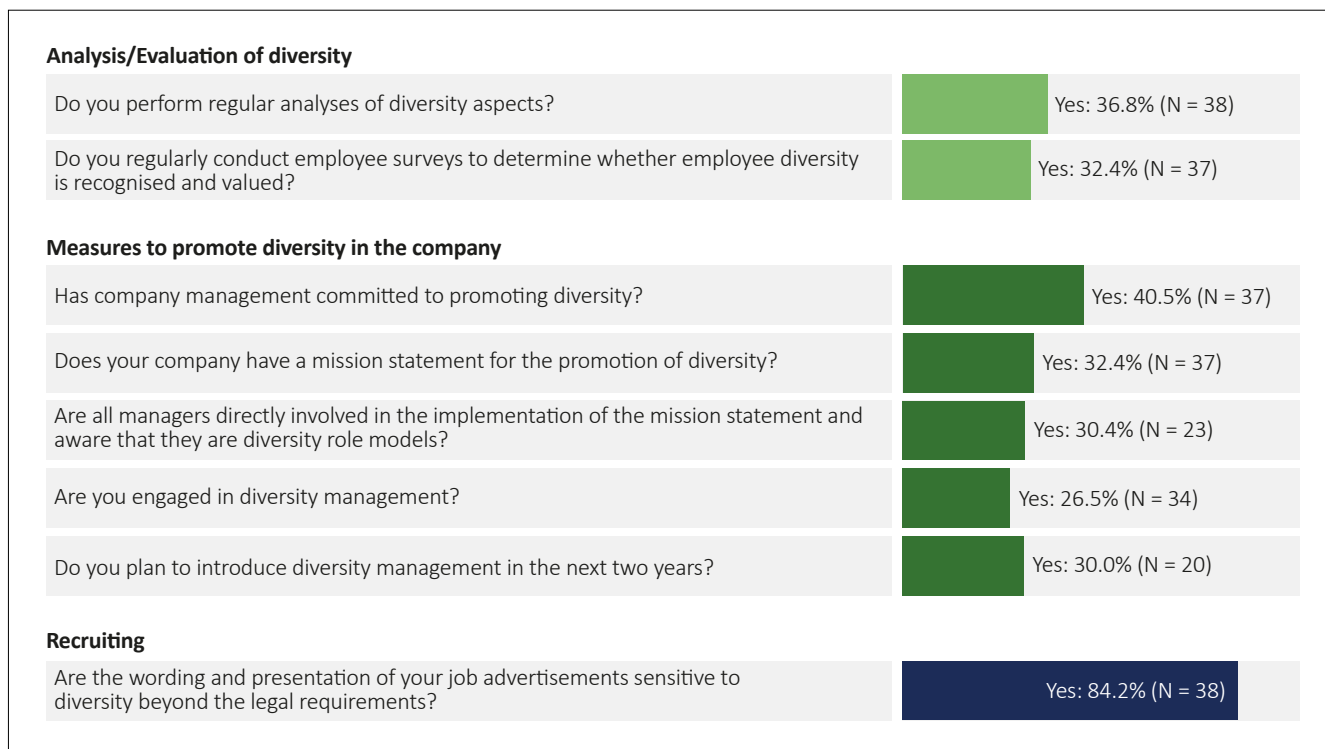


Figure 25: Summary of diversity measures implemented in the surveyed companies in 2022. (Source: Online survey 2022, VDI-VDE-IT, in-house representation)

Analyses and evaluations of diversity

To what extent are companies that implement diversity measures actually diverse? To answer this question, the differences in the extent of diversity in companies with and without diversity measures were investigated.

Differences in the extent of diversity were apparent between companies that performed diversity analyses and those that did not. In companies where analyses of diversity aspects were performed regularly, a slightly higher proportion of women (at 28%) and age diversity (at 13%) was observed compared to companies where such analyses were not performed (see Table 5). An even greater effect was observed

for companies regularly conducting employee surveys to determine whether employee diversity was recognised and valued which showed a more positive effect on the proportion of women. No measurable difference was observed for age diversity in that respect (see Table 6).

Throughout the data analysis the median values (instead of mean values) were determined and evaluated. Only values based on at least ten cases are reported. Since the number of cases for the information on the proportion of foreign nationals was too low, corresponding analyses was omitted.

Do you perform regular analyses of diversity aspects?				
	Proportion of women		Age diversity	
Answer	Yes	No	Yes	No
Median	28 %	25 %	13 %	16 %
Number of responses	14	24	12	24
Source: Online survey 2022, VDI-VDE-IT.				

Table 5: Proportion of women and age diversity in the surveyed companies linked to implemented diversity measure in 2022: Do you perform regular analyses of diversity aspects?

Do you regularly conduct employee surveys to determine whether employee diversity is recognised and valued?				
	Proportion of women		Age diversity	
Answer	Yes	No	Yes	No
Median	29 %	25 %	14 %	15 %
Number of responses	12	25	12	23
Source: Online survey 2022, VDI-VDE-IT.				

Table 6: Proportion of women and age diversity in the surveyed companies linked to implemented diversity measure in 2022: Do you regularly conduct employee surveys to determine whether employee diversity is recognised and valued?

Measures to promote diversity in the company

Employee diversity was higher in the surveyed companies where the promotion of diversity had been formalised than in companies where such measures had not been formalised (see Table 7). Interestingly, a commitment to the promotion of diversity by company management was apparently more effective than “just” having a mission statement for the promotion of diversity. In particular, the proportion of

women in the surveyed companies was higher only when there was a commitment in place, while the mere existence of a mission statement (see Table 8) did not seem to have any effect on either of the two examined dimensions. With respect to great caution in interpreting the results, this indicates that a higher level of accountability for the implementation of diversity measures reveals a greater efficiency for their realisation (also see Section 4.2.1).

Has company management committed to promoting diversity?				
	Proportion of women		Age diversity	
Answer	Yes	No	Yes	No
Median	30 %	25 %	14 %	15 %
Number of responses	15	22	12	22
Source: Online survey 2022, VDI-VDE-IT.				

Table 7: Proportion of women and age diversity in the surveyed companies linked to implemented diversity measure in 2022: Has company management committed to promoting diversity?

Does your company have a mission statement for the promotion of diversity?				
	Proportion of women		Age diversity	
Answer	Yes	No	Yes	No
Median	25 %	25 %	14 %	15 %
Number of responses	12	25	11	23
Source: Online survey 2022, VDI-VDE-IT.				

Table 8: Proportion of women and age diversity in the surveyed companies linked to implemented diversity measure in 2022: Does your company have a mission statement for the promotion of diversity?

3.3.2 Online survey methodology and approach

How were the data recorded and prepared?

The online survey investigated in total 11 dimensions. The questionnaire was distributed among a relevant group of battery value chain stakeholders. They were approached by e-mail and asked to participate. The objective was to generate figures on the extent of diversity and on diversity measures implemented in the surveyed companies. Data were collected from 54 companies in this manner.

Survey design

The objective of the survey was to generate figures on the extent of diversity and on diversity measures implemented in the surveyed companies. In addition interviews with people in the battery ecosystem from within the Federal German Funding Framework were conducted. The interview results are presented in the analysis section. The interviews mainly served as guidance to contextualise the results of the online survey. They provided an opinion that resembled in part results from additional literature research.

The demographic dimensions of the survey were: (1) Proportion of women (in %), (2) proportion of employee age categories (in %, the age categories were: <20 years, 20-29 years, 30-39 years, 40-49 years, 50-59 years, ≥ 60 years), and (3) proportion of foreign nationals (in %).

The remaining eight surveyed dimensions focussed on the characteristics of the diversity measures and were in the manner of yes/no-responses: (4) Do you perform regular analyses of diversity aspects?, (5) Do you regularly conduct employee surveys to determine whether employee diversity is recognised and valued?, (6) Has company management committed to promoting diversity?, (7) Does your company have a mission statement for the promotion of diversity?, (8) Are all managers directly involved in the implementation of the mission statement and aware that they are diversity role models?, (9) Are you engaged in diversity management?, (10) Do you plan to introduce diversity management in the next two years?, and (11) Are the wording and presentation of your job advertisements sensitive to diversity beyond the legal requirements?

What assumptions were made?

The extent to which companies offered various diversity measures was presented. Whether certain measures were more prevalent than others, such as measures with accountability versus measures without accountability, was an open question. A hypothesis was that companies that are offering diversity measures are more diverse on average than other companies. For example, such companies offering diversity measurements were expected to have a more equally balanced proportion of men and women among their employees. Measures with a higher degree of accountability (for example, the commitment of the company management for the promotion of diversity) were expected to have a greater effect on the promotion of diversity than “softer” measures, such as having a mission statement for the promotion of diversity.

What was analysed?

Means, proportional values, medians and standard deviations were determined in each of the above mentioned eleven dimensions. Firstly, the diversity of the surveyed companies was investigated regarding gender, age structure, the proportion of foreign nationals and to what extent these companies offered measures to promote diversity.

The following age categories were applied to determine the age structure: < 20 years, 20-29 years, 30-39 years, 40-49 years, 50-59 years and ≥ 60 years. A higher weighting was assigned in the following to age categories “< 20 years” and “≥ 60 years” in order to have their proportions represent full decades (like all the other categories). In particular the proportions for the categories “< 20 years” and “≥ 60 years” were weighted with 2.5 and 2, respectively. This was based on the assumption that four cohorts were included in the statistics in “< 20 years” and around five cohorts in “≥ 60 years”. With the weighting, the proportions represent now for a full decade. The diversity of the age structure was determined through the standard deviation of the mean of the proportions in the six age categories. Namely, a low standard deviation (limit value 0) means a more even distribution of the employees across the age categories (thus high age diversity), while a higher standard deviation (limit value 37, 27) representing a more uneven distribution of the employees across the age categories (thus lower age diversity).

Subsequently the differences between the mean values were presented, revealing to what extent companies with measures promoting diversity had a higher proportion of women or higher diversity of the age structure.

Limitation

Since the survey was conducted anonymously, multiple responses could not be excluded. The ability to present bivariate distributions was limited by the small number of cases (n=54 companies). The results have to be interpreted with great caution because of the rather small number of cases. Only figures based on at least ten cases were taken into account and presented. Therefore, the extent to which values differ between companies with and without measures could only be presented for the proportion of women and age diversity in the company. The number of cases is too small for the responses on the proportion of foreign nationals (a high number of “n/a” responses were observed).

4 PROMOTION OF DIVERSITY IN BATTERY CELL MANUFACTURING – RECOMMENDATIONS

Appropriate general conditions make diversity key tool for addressing the shortage of skilled talents. Not only does it promote creativity in teams, but it is also important for competing in the labour market (Federal Government 2022⁷⁵).

As outlined in the previous sections, in battery cell manufacturing there is still much progress to be made in promoting employee diversity, especially in leadership positions, and providing opportunities for e. g., women and men as well as foreign nationals and Germans. Nevertheless, the starting point is promising since the proportion of women is higher than in STEM occupations in general and the proportion of women and foreign nationals is higher in this economic sector than expected in the respective skilled occupations. Thus a foundation has been laid in various areas to realise the potential of diversity. Employee diversity makes employers more attractive in the labour market and provides a resource for exchanging of experiences, flexibility and thus resilience in the face of changes in the working world.⁷⁶ Diversity holds various potential for innovation and the company success making it a valuable tool for addressing the shortage of skilled talents. However, implementation appropriate steps to actually harvest this potential.

In the following section, the necessary steps are outlined including recommendations and concrete measures focusing on the following key aspects: leadership, company culture, recruitment and career. These areas are closely linked and influence each other.

75 Federal Government (2022): Fachkräftestrategie der Bundesregierung. Published by Federal Ministry of Labour and Social Affairs. Berlin. Available at: https://www.bmas.de/SharedDocs/Downloads/DE/Publikationen/fachkraeftestrategie-der-bundesregierung.pdf?__blob=publicationFile&v=5, accessed: 17.10.2022.

76 See https://www.diko-berlin.de/app/download/9238126376/Mit%20Vielfalt%20durch%20die%20Krise_Resilienz-Check_final.pdf?t=1633090185 [Accessed on 24.03.2023]

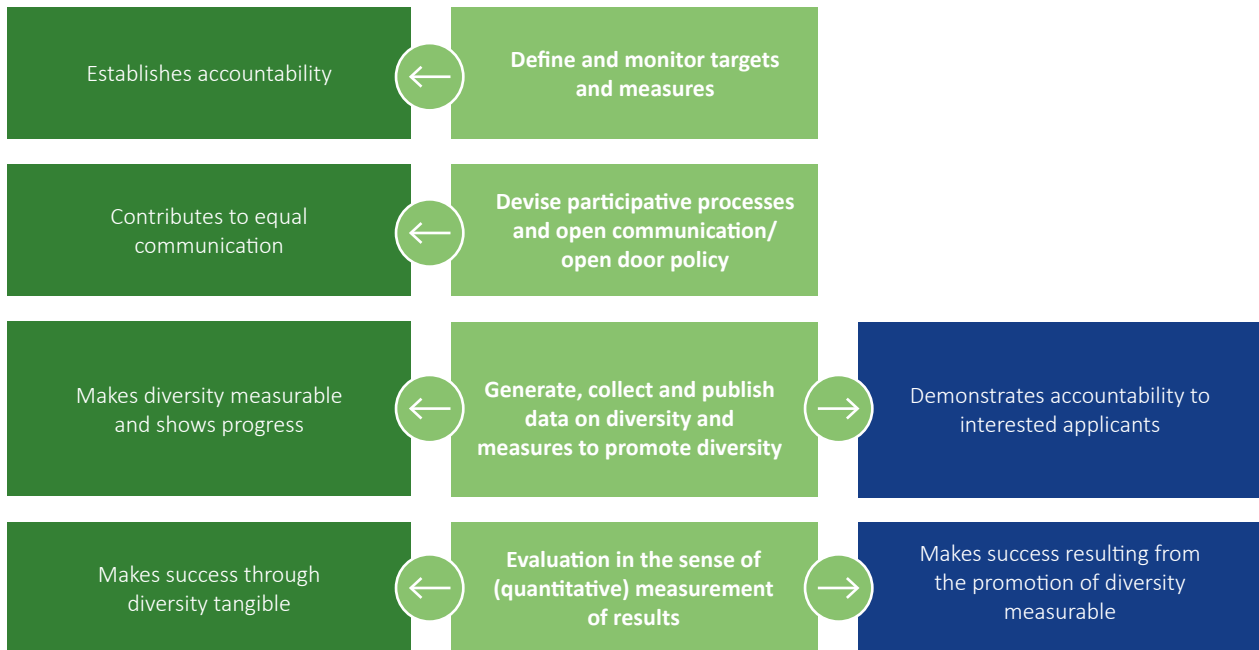
Overview of measures and their effects for the recruitment and retention of talents

Figure 26 presents an overview of concrete diversity-oriented measures addressed in the following, among others, and their effects for the recruitment and retention of talents.

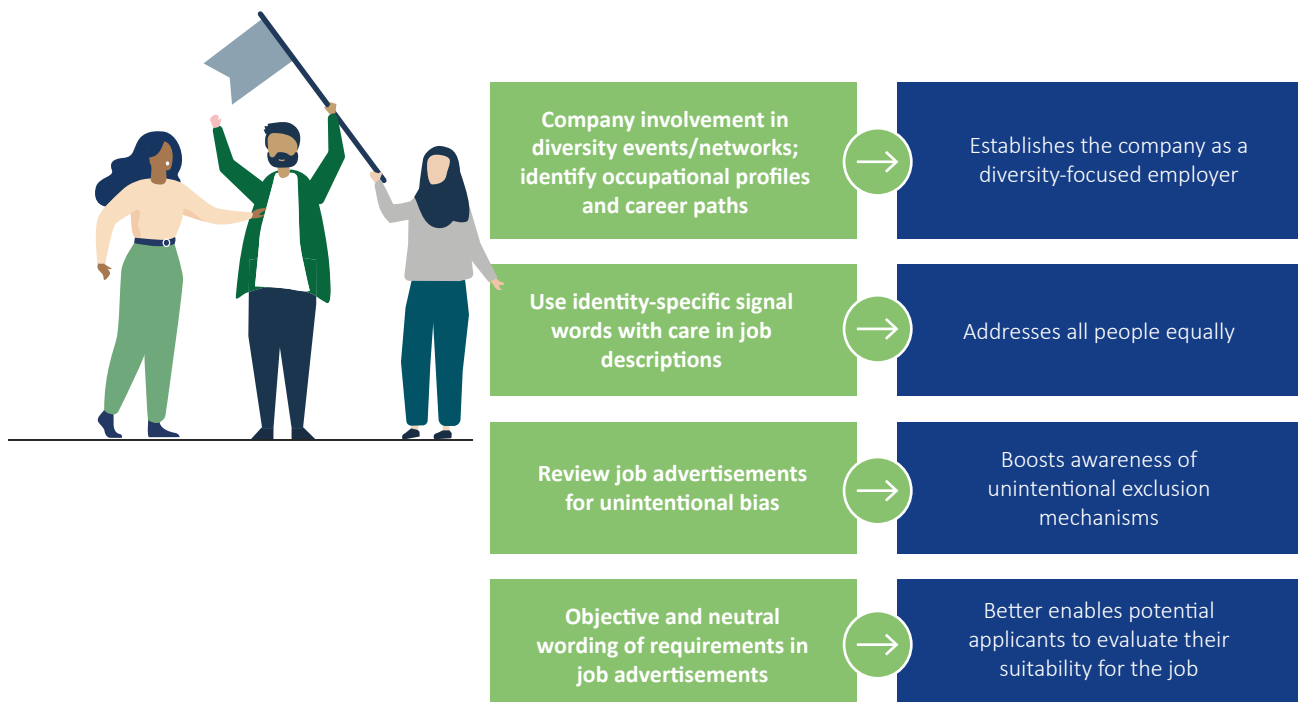


Effect for the retention of talents

Effect for the recruitment of talents



Corporate culture to the outside



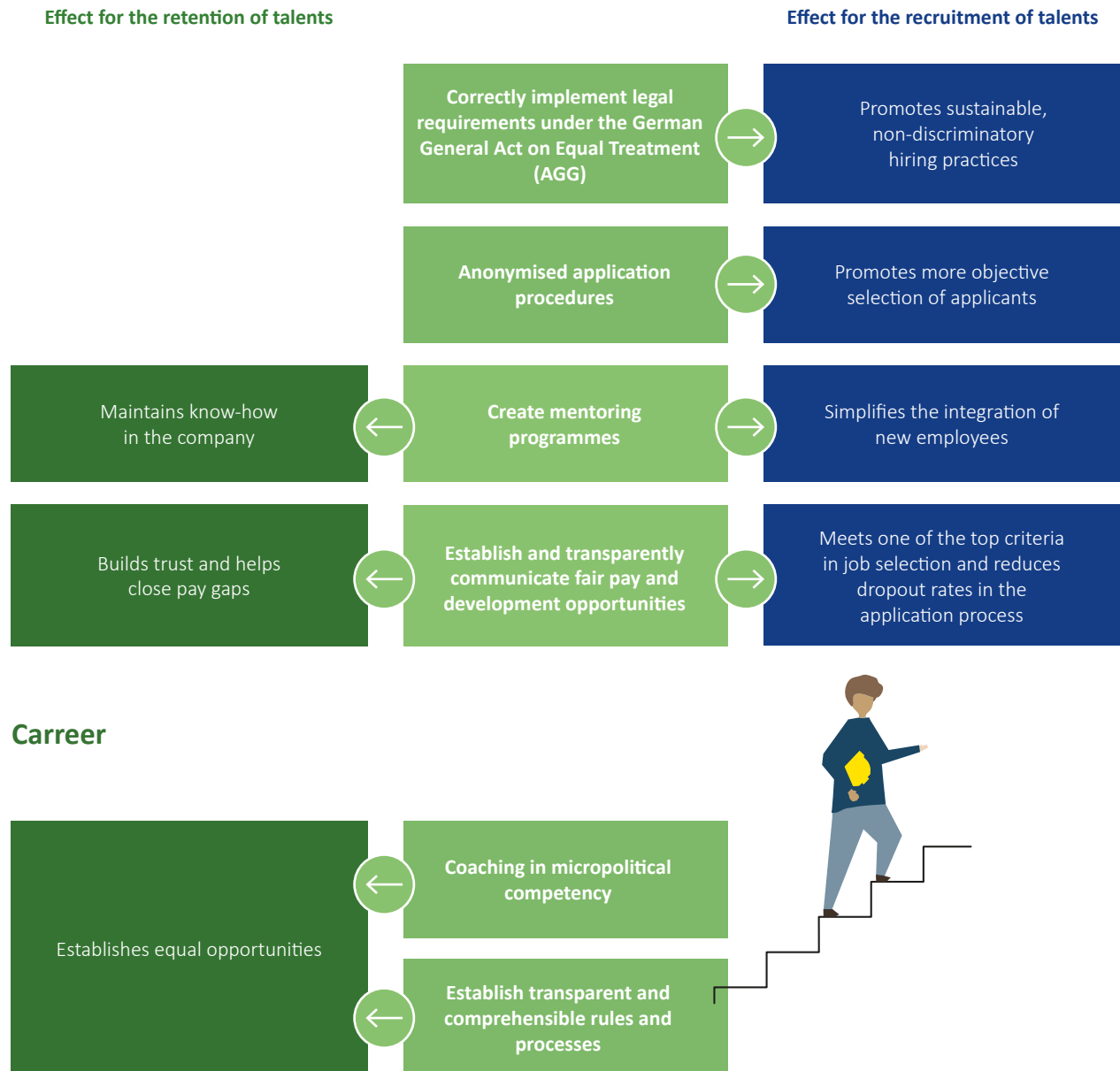


Figure 26: Overview of measures and their effects for the recruitment and retention of talents based on the key aspects of leadership, company culture, recruitment and career; in-house representation.

4.1 Diverse managers with diversity-oriented competencies

Key findings

Managers play a central role in the implementation of diversity management in companies. Teaching diversity-oriented competencies is therefore a key aspect of management development for the effective implementation of diversity management. Managers who are knowledgeable about diversity issues can better understand and support the need of employees, resulting in improved job satisfaction and retention. Furthermore, a diverse management team helps facilitate the implementation of diversity management.

Managers play a central role for the implementation of diversity management in companies from two perspectives: They serve as role models in the company and have the authority to implement changes. It is therefore important (1) to increase diversity at the management level and (2) to make managers aware of the challenges and potential of diversity.

(1) Increasing diversity at the management level:

Breaking down prejudices: It stands to reason that diverse organisation demographics, especially in leadership positions, result in employee diversity: Prejudices can be broken down through social contacts taking place at work, for instance between men and women or between people of various origins, and through positive experiences in teams ("Contact hypothesis", see Fields and Blum 1997⁷⁷). These positive experiences can lead to a more positive view of diversity, and more diverse hiring by the company.

Avoiding defensive reactions: Diversity at the management level does not automatically result in breaking down discrimination and in the promotion of diversity. Instead, conflicts over scarce resources may increase: A change in the gender distribution, for example, may be perceived as competition and cause defensive reactions ("Conflict hypothesis", see

Allmendinger and Hackman 1994⁷⁸). To avoid such defensive reactions, it is important to establish measures that make managers aware of diversity.

(2) Making managers aware of diversity:

To realise the potential of diversity over the long term, managers need to be educated about diversity and should understand the potential it harbours. The middle management level is considered a key position for changes (change agents), as they are the ones who will ultimately implement and put into practice the diversity strategies introduced by top management (Dreas and Rastetter 2016⁷⁹). Thus it is essential to develop the necessary diversity competence especially in this level. When comparing the management levels "supervisors" and "managers", this applies mainly to supervisors in the battery industry – where foreign nationals in particular are under-represented at 5% (compared to 10% for managers; see Section 3.1.1).

Using continuing education programmes: *Diversity training and awareness coaching* for managers aim to impart skills for the effective implementation of diversity management. Such skills include gender-sensitive communication, intercultural leadership, conflict solution, and diversity-oriented recruitment and personnel development (Wittpahl et al. 2020⁸⁰). For example, the "Kompetenzzentrum Technik Diversity Chancengleichheit" e. V. (kompetenzz), an affiliated institute of the Bielefeld University of Applied Sciences, offers such training and general consultancy on the topic of diversity management.⁸¹ The competence centre focuses, in particular, on promoting women in STEM occupations, which is of special relevance for this study with a focus on battery cell production.

Building awareness: To build diversity competence among managers, awareness training and skill-building are two effective formats (Dreas and Rastetter 2016⁸²): *Awareness training* is designed to draw attention to diversity-related topics and build awareness of cultural backgrounds, attitudes and expectations as well as possible conflicts. This training includes awareness of social power imbalances,

77 Fields, Dail L.; Blum, Terry C. (1997): Employee satisfaction in work groups with different gender composition. In: Journal of Organizational Behavior 18 (2), p. 181–196.

78 Allmendinger, Jutta; Hackman, J. Richard (1994): Akzeptanz oder Abwehr? Die Integration von Frauen in professionelle Organisationen. In: Kölner Zeitschrift für Soziologie und Sozialpsychologie 46 (2), p. 238–258.

79 Dreas, Susanne; Rastetter, Daniela (2016): Die Entwicklung von Diversity Kompetenz als Veränderungsprozess. In: Genkova, Petia und Tobias Ringeisen (Publisher): Handbuch Diversity Kompetenz. Wiesbaden: Springer, S. 351–369.

80 Wittpahl, Volker; Buhr, Regina; Kelterborn, Peggy (2020): Rahmen- und Arbeitsbedingungen für Frauen in der Internetwirtschaft. Ist-Situation und Handlungsempfehlungen. Published by Institut für Innovation und Technik (iit) in VDI/VDE Innovation + Technik GmbH. Berlin. Available at: https://www.iit-berlin.de/iit-docs/a4a18d83592c409abdc0769450370960_2020-07-iit_Eco-Studie_aktualisiert.pdf, accessed: 04.08.2022.

81 <https://www.kompetenzz.de/aktivitaeten/beratung-der-fh-bielefeld> [Accessed on 24.03.2023]

82 Dreas, Susanne; Rastetter, Daniela (2016): Die Entwicklung von Diversity Kompetenz als Veränderungsprozess. In: Genkova, Petia und Tobias Ringeisen (Publisher): Handbuch Diversity Kompetenz. Wiesbaden: Springer, S. 351–369.

social construction processes and stereotypes, with the objective of developing solution strategies to overcome them.⁸³ For example, reflective exercises can be employed to empathize with others. Participants are trained to act appropriately and sensitively in situations defined by diversity, and are prepared for possible irritations. *Skill-building training*, on the other hand, focuses on imparting skills and knowledge, especially to managers and personnel management (top-down). This sharing of knowledge should involve the active participation of managers, for example, in workshop formats where the imparted knowledge is integrated with strategies for implementation. Such training and consultancy programmes are of central importance for battery cell manufacturing companies to make management more diverse, with diversity-oriented competencies. It is important to recognise the need for such measures and to promote them accordingly by providing the necessary time and funds.

Using digital formats The current, rapid development of *digital learning and teaching formats* can help with the implementation of corresponding formats. Since they are flexible (in terms of time and location), they can also contribute to a better work/family balance (Mah et al. 2019⁸⁴).

At the same time, just creating such consultancy offers is not sufficient. Their mere existence can also serve as a “legitimation façade”, signalling that “enough has now been done” to establish equal opportunities without the measures actually gaining acceptance (Busch-Heizmann et al. 2018⁸⁵). That is true in particular if they are contrary to the practised company culture. This aspect and possible solutions to build an egalitarian company culture are described in the next section.

4.2 A company culture that values diversity

4.2.1 Diversity from the inside

Key findings

Valuing diversity and incorporating diversity into the company culture promotes a working environment that makes a significant contribution to employee satisfaction and productivity. As the battery industry sees the establishment of numerous new companies and divisions, the sector has a unique opportunity to make diversity an integral part of the company culture from the outset.

In a more traditional company culture, increased accountability for diversity measures can help facilitate their implementation. Positive experiences with diversity favour a (gradual) cultural shift over time. It is important to acknowledge resistance to changes and actively address it, while systematically incorporating it into change processes. Making the introduction of diversity management a participative process encourages the development of joint solutions that benefit everyone and are considered meaningful by all parties.

83 Emphasising the (perceived) differences can also be viewed as problematic since this emphasis can further reproduce the differences (“Self-Fulfilling Prophecy”). Yet it can help develop an awareness of existing problems as a first step.

84 Mah, Dana-Kristin; Büching, Corinne; Brzoska, Stefanie (2019): Wissenschaftliche Weiterbildung 4.0. Digitale Lehr- und Lernformen, Verfahren und Fachthemen. Published by Institut für Innovation und Technik (iit) in der VDI/VDE Innovation + Technik GmbH. Berlin. Available at: https://www.iit-berlin.de/iit-docs/c8a63a9d92e54f62bd4af5570dcaf30f_Wissenschaftliche-Weiterbildung_4.0_iit-2019.pdf, accessed: 04.08.2022.

85 Busch-Heizmann, Anne; Rastetter, Daniela; Rinke, Timothy (2018): Geschlechterungleichheit in Erwerbsorganisationen – Zur Verschränkung von „Struktur“ und „Kultur“. In: *Arbeit. Zeitschrift für Arbeitsforschung, Arbeitsgestaltung und Arbeitspolitik* 27 (1), p. 49–75.

Company culture refers to “specific convictions, values and symbols that develop in an organisation over time, and that informally define the actions of the organisation’s members” (Cornils et al. 2012; quoted from Schreyögg 2008⁸⁶). Thus the company culture is an “orientation pattern” within the organisation – for example, in the form of rituals, attire and interactions – for “appropriate” conduct in the company (Cornils et al. 2012⁸⁷). Presumably, company cultures in battery cell manufacturing are primarily based on the reality of life as experienced by men, since they make up the largest proportion of the employees and in particular also the managers (see Section 3.1.1). But since this industry is also relatively young, there is potential for openness, flexibility and willingness to change.

Two aspects have to be considered in the discussion of the (diversity-friendly) company culture: On the one hand, the aspect of values, and on the other hand, the company structures. Diversity-friendly company structures can favour a diversity-friendly system of values within the organisation and contribute to a corresponding culture (Busch-Heizmann and Rinke 2018; Wittpahl et al. 2020⁸⁸).

Formalising HR policies: Formalising HR policies can promote diversity within company structures. This includes the institutionalised representation of interests (a works council, for example), equal opportunity and diversity officers, and the formalisation of HR management processes (for example, collective agreements, formal career frameworks) (Busch-Heizmann and Rinke 2018⁸⁹). However, it is important to ensure that such measures also are visible within the company and that accountability is defined. Merely having a “legitimation façade” or “equality myth” (Funder and May 2014⁹⁰), with the attribution of stereotypes and statistical discrimination continuing in the background, must be avoided. Empirically the gender pay gap, for example, is smaller in companies with than those without a works council or staff council, but not in companies with provisions (presumably with little accountability) such as company equal opportunity guidelines (Busch-Heizmann and Rinke 2018⁹¹).

86 Cornils, Doris; Mucha, Anna; Rastetter, Daniela (2012): Zur Bedeutung von mikropolitischen Kompetenz für den Aufstieg von Frauen in Führungspositionen – am Beispiel der Handlungsfelder Unternehmenskultur und Selbstdarstellung. In: Gruppendynamik und Organisationsberatung. Zeitschrift für angewandte Sozialpsychologie 43 (3), p. 225–244.

87 Cornils, Doris; Mucha, Anna; Rastetter, Daniela (2012): Zur Bedeutung von mikropolitischen Kompetenz für den Aufstieg von Frauen in Führungspositionen – am Beispiel der Handlungsfelder Unternehmenskultur und Selbstdarstellung. In: Gruppendynamik und Organisationsberatung. Zeitschrift für angewandte Sozialpsychologie 43 (3), p. 225–244.

88 Busch-Heizmann, Anne; Rinke, Timothy (2018): Der Einfluss betrieblicher Strukturen auf die Verdienste von Frauen und Männern. Ergebnisse der Betriebsbefragung des sozio-oekonomischen Panels (SOEP-LEE). In: WSI-Mitteilungen 2018 (2), S. 114–123. Available at: https://www.wsi.de/data/wsimit_2018_02_busch-heizmann.pdf, accessed: 04.08.2022.; Wittpahl, Volker; Buhr, Regina; Kelterborn, Peggy (2020): Rahmen- und Arbeitsbedingungen für Frauen in der Internetwirtschaft. Ist-Situation und Handlungsempfehlungen. Published by Institut für Innovation und Technik (iit) in VDI/VDE Innovation + Technik GmbH. Berlin. Available at: https://www.iit-berlin.de/iit-docs/a4a18d83592c409abdc0769450370960_2020-07-iit_Eco-Studie_aktualisiert.pdf, accessed: 04.08.2022.

89 Busch-Heizmann, Anne; Rinke, Timothy (2018): Der Einfluss betrieblicher Strukturen auf die Verdienste von Frauen und Männern. Ergebnisse der Betriebsbefragung des sozio-oekonomischen Panels (SOEP-LEE). In: WSI-Mitteilungen 2018 (2), S. 114–123. Available at: https://www.wsi.de/data/wsimit_2018_02_busch-heizmann.pdf, accessed: 04.08.2022.

90 Funder, Maria; May, Florian (2014): Neo-Institutionalismus: Geschlechtergleichheit als Egalitätsmythos? In: Maria Funder (Publisher): Gender Cage-Revisited. Handbuch zur Organisations- und Geschlechterforschung. Baden-Baden: Nomos, p. 195–224.

91 Busch-Heizmann, Anne; Rinke, Timothy (2018): Der Einfluss betrieblicher Strukturen auf die Verdienste von Frauen und Männern. Ergebnisse der Betriebsbefragung des sozio-oekonomischen Panels (SOEP-LEE). In: WSI-Mitteilungen 2018 (2), S. 114–123. Available at: https://www.wsi.de/data/wsimit_2018_02_busch-heizmann.pdf, accessed: 04.08.2022.

Balance and workplace flexibility⁹²: Measures taken by companies to promote work/family balance and working time flexibility can also foster equal opportunities and diversity. Family-oriented measures can provide relief for employees with family obligations (traditionally women in particular), allowing them to invest more time and energy in their career. For example, empirical results indicate a reduction of earnings inequality in companies with family-oriented measures. However, this mainly manifests itself in lower income classes (Huffman et al. 2017⁹³).

However, when employees utilise these measures, it can lead to negative assessments, as it goes against the cultural norm of a worker who is fully available to the labour market (Lott and Klenner 2016⁹⁴). This is known as “flexibility stigma” (Williams et al. 2013⁹⁵). Empirical results indicate that workplace flexibility measures reduce the gender pay gap, while work/family balance initiatives (such as company day-care) actually increase the gender pay gap in companies (Busch-Heizmann and Rinke 2018⁹⁶).

Measure	Company culture: Implement binding work-life/family balance and workplace flexibility measures
Description	Measures that provide relief for employees with family responsibilities can help equalise earnings and career opportunities between employees with and without such responsibilities. They can also raise awareness of work-life/family balance issues and improve the understanding and acceptance of non-traditional career paths. However, utilising such measures can also result in stigma, and workplace flexibility can blur the lines between work and private life. To address these challenges, it is important for these measures be supported by a corresponding lasting, open and egalitarian company culture.
Motivation	The gender pay gap and glass ceiling remain clearly apparent, also in battery cell production. Empirical results suggest that workplace flexibility measures can reduce the gender pay gap in companies, while work/family balance initiatives can increase it (Busch-Heizmann and Rinke 2018 ⁹⁷). Therefore, the effectiveness of such measures is linked to conditions. Presumably they only help promote diversity if the company has a mission statement that values diversity and that perceives and appreciates differences as enriching, and actually puts this into practice.
Implementation	Examples of work/family balance measures include offering company day-care and parent-child workplaces, or financial support for child care. Examples of workplace flexibility measures include options for independent time management and adjusting the length or scheduling of working hours, or options for working from home. When these measures are supported by (practised) company mission statements to promote diversity, they can improve the career opportunities for disadvantaged groups.

Table 9: Good practice example based on the concrete measure, its description, the motivation behind it and the implementation. “Implement binding work-life/family balance and workplace flexibility measures”.

- 92 Workplace flexibility means the flexibility for employers to adjust working conditions as they suit them, especially regarding working hours and where work is performed. The extent of workplace flexibility offered can vary among companies, depending on their respective objectives and requirements.
- 93 Huffman, Matt; King, Joseph; Reichelt, Malte (2017): Equality for whom? Organizational policies and the gender gap across the German earnings distribution. In: ILR Review 70 (1), p. 16–41.
- 94 Lott, Yvonne; Klenner, Christina (2016): Ideal workers and ideal parents. Working-time norms and the acceptance of part-time and parental leave at the workplace in Germany. WSI Working Paper 204. Published by WSI. Düsseldorf. Available at: https://www.boeckler.de/de/faust-detail.htm?sync_id=HBS-006423, accessed: 10.08.2022.
- 95 Williams, Joan C.; Blair-Loy, Mary; Berdahl, Jennifer L. (2013): Cultural Schemas, Social Class, and the Flexibility Stigma. In: Journal of Social Issues 69 (2 (Special Issue: The Flexibility Stigma)), p. 209–234.
- 96 Busch-Heizmann, Anne; Rinke, Timothy (2018): Der Einfluss betrieblicher Strukturen auf die Verdienste von Frauen und Männern. Ergebnisse der Betriebsbefragung des sozio-oekonomischen Panels (SOEP-LEE). In: WSI-Mitteilungen 2018 (2), S. 114–123. Available at: https://www.wsi.de/data/wsimit_2018_02_busch-heizmann.pdf, accessed: 04.08.2022.
- 97 Busch-Heizmann, Anne; Rinke, Timothy (2018): Der Einfluss betrieblicher Strukturen auf die Verdienste von Frauen und Männern. Ergebnisse der Betriebsbefragung des sozio-oekonomischen Panels (SOEP-LEE). In: WSI-Mitteilungen 2018 (2), S. 114–123. Available at: https://www.wsi.de/data/wsimit_2018_02_busch-heizmann.pdf, accessed: 04.08.2022.

Overall, it appears that binding formalisation measures and workplace flexibility tend to promote equality, while the effect of measures with less accountability and work/family balance measures may be more ambivalent. It is therefore important for measures to be accompanied by a “fitting” company culture that is open, flexible and diversity-friendly.

Potential of workplace flexibility

The potential of flexibility – supported by the increasing digitalisation of work conditions – for a better work/family balance is critically discussed in the literature⁹⁸. On the one hand, more freedom in scheduling one’s own workplace can create new opportunities for the flexible coordination of gainful employment, family and recreation. On the other hand, the requirement to organise and manage one’s own working time can blur the lines between work and private life⁹⁹, and thus actually become a burden. The extent to which this model can be used as a resource or tends to become a burden can be presumed to differ between women and men, and between occupational positions¹⁰⁰.

Thus the effectiveness of such measures for a lasting company culture that values diversity is linked to conditions:

Value system in the company: From the value perspective, a company culture that values diversity is defined by appreciating differences and perceiving them as enrichments (Wittpahl et al. 2020¹⁰¹). Even though the management level may initially be confronted with greater personnel management demands as a result of diversity, this is not interpreted as a burden but as desirable. This is supported by studies that prove the success of diversity management in companies (Charta der Vielfalt e.V. 2022¹⁰²). Performance is not perceived through the lens of stereotypical roles (any more), but viewed neutrally according to individual competencies and work performance in the operation (Wittpahl et al. 2020¹⁰³). Also, the system of values is no longer based on the full availability of labour, but accepts alternative aspirations and flexibility in attaining a work/family balance. *Effectively incorporating diversity and openness in the company culture is the goal.*

98 see in summary Busch-Heizmann, Entgelmeier, & Rinke, 2018

99 so-called blurring, see Voß, 1998

100 for an empirical study see Lott, 2020

101 Wittpahl, Volker; Buhr, Regina; Kelterborn, Peggy (2020): Rahmen- und Arbeitsbedingungen für Frauen in der Internetwirtschaft. Ist-Situation und Handlungsempfehlungen. Published by Institut für Innovation und Technik (iit) in VDI/VDE Innovation + Technik GmbH. Berlin. Available at: https://www.iit-berlin.de/iit-docs/a4a18d83592c409abdc0769450370960_2020-07-iit_Eco-Studie_aktualisiert.pdf, accessed: 04.08.20

102 Charta der Vielfalt e.V. (2022): Factbook Diversity. Published by Charta der Vielfalt e.V. Berlin. Available at: https://www.charta-der-vielfalt.de/fileadmin/user_upload/Diversity-Tag/2022/Deutscher_Diversity-Tag_2022/Factbook_2022.pdf, accessed: 15.08.2022.

103 Wittpahl, Volker; Buhr, Regina; Kelterborn, Peggy (2020): Rahmen- und Arbeitsbedingungen für Frauen in der Internetwirtschaft. Ist-Situation und Handlungsempfehlungen. Published by Institut für Innovation und Technik (iit) in VDI/VDE Innovation + Technik GmbH. Berlin. Available at: https://www.iit-berlin.de/iit-docs/a4a18d83592c409abdc0769450370960_2020-07-iit_Eco-Studie_aktualisiert.pdf, accessed: 04.08.20

Accountability: Increasing accountability for measures can help ensure that they are in fact implemented, notwithstanding a possibly more traditional company culture. This leads to positive experiences so that cultures can (gradually) change, for example, through *supervisory bodies* or a *commitment by company management to promote diversity*. Section 3.3.1 showed that such a commitment positively correlates with the proportion of women and age diversity in battery cell manufacturing companies. Implementing *diversity competency as a criterion for promotion* is another possibility: This can act as a reinforcing signal to examine the topic of diversity and to recognise it as a specific qualification for career advancement (Dreas and Rastetter 2016¹⁰⁴). *Setting and monitoring company targets and requirements* can also contribute to accountability (see Section 4.2.2 for the evaluation of measures).

Participation: Recognising resistance to changes is also important. Such resistance is not only common but human. Resistance has to be systematically incorporated in the change process. This can be accomplished when the development of diversity competence is understood as a longer-term and especially also a *participative process* (Dreas and Rastetter 2016¹⁰⁵): It means that consultancy and continuing education offers are open to all employees, not only certain groups. One has to recognise that diversity not only leads to improvement for certain groups, but simultaneously endangers the status of the privileged groups. That leads to fears, uncertainties and the resulting resistance against the background of scarce resources (see above). Participative processes that include everyone can help to first identify and work out the existing constellations of interests, and to develop joint solutions that all parties consider meaningful and that benefit everyone. When such processes lead to the conviction that everyone can personally benefit from the change, the success of change processes improves. Thus top-down and bottom-up approaches have to be combined. Examples of bottom-up approaches include needs-based, independently operating *networks and working groups or open*, flexible and creative contribution formats such as *future labs* (Dreas and Rastetter 2016¹⁰⁶).

Measure	Company management states a commitment to promoting diversity
Description	Company management is convinced that employee diversity adds value. Differences are not merely tolerated but appreciated. Support for and the commitment to promoting diversity is communicated to managers and openly addressed with the employees. This can be implemented in the form of a self-commitment with targets and indicators that can be subsequently evaluated.
Motivation	The commitment of company management is one of the most important prerequisites to establish the right general conditions for diversity in the company. When differences are recognised as a gain for the company, they can be put to productive use.
Implementation	The analyses of the online survey (see Section 3.3.1) indicate that measures for diversity in the company are most effective in conjunction with accountability. Building awareness, for instance through diversity guidelines, can change the company culture over the long term and provide the crucial impetus for a commitment by company management to promoting diversity.

Table 10: Good practice example based on the concrete measure, its description, the motivation behind it and the implementation. “Company management makes a commitment to promoting diversity”.

104 Dreas, Susanne; Rastetter, Daniela (2016): Die Entwicklung von Diversity Kompetenz als Veränderungsprozess. In: Genkova, Petia und Tobias Ringeisen (Publisher): Handbuch Diversity Kompetenz. Wiesbaden: Springer, S. 351–369.

105 Dreas, Susanne; Rastetter, Daniela (2016): Die Entwicklung von Diversity Kompetenz als Veränderungsprozess. In: Genkova, Petia und Tobias Ringeisen (Publisher): Handbuch Diversity Kompetenz. Wiesbaden: Springer, S. 351–369.

106 Dreas, Susanne; Rastetter, Daniela (2016): Die Entwicklung von Diversity Kompetenz als Veränderungsprozess. In: Genkova, Petia und Tobias Ringeisen (Publisher): Handbuch Diversity Kompetenz. Wiesbaden: Springer, S. 351–369.

Open communication in the company (open door policy) can contribute to exchanges between different groups as equals.

Diversity officers Appointing diversity officers can be a means to implement change processes. Here too, success is linked to conditions. The job profile must be clearly outlined and resources, skills and job protection are required so their appointment is not merely a “sham measure” (Dreas and Rastetter 2016¹⁰⁷).

Consideration of gender-sensitive language: Guidelines for the use of gender-sensitive language can also help promote employee awareness of diversity. However, this does not happen automatically. If there is great scepticism about diversity in the company, mistakes of under-represented people can be given greater weight and interpreted as proof of incompetence.

Measure	Guidelines for the use of gender-appropriate and diversity-sensitive language
Description	Guidelines for gender-appropriate and diversity-sensitive language exist in external and internal corporate communications and should be followed. A handbook with suggested wording, examples and further information is provided to the employees.
Motivation	Gendering in particular is possible in many forms. Established guidelines and a handbook for orientation help eliminate usage uncertainties and establish a uniform understanding. Language and images shape the human imagination. Gender-appropriate and diversity-sensitive communication expands the imagination and creates visibility for more people. This can have positive effects ¹⁰⁸ on equality.
Implementation	The accompanying research battery cell production published corresponding helpful information in 2021 (Martin et al. 2021 ¹⁰⁹). It contains forms of gender, sample wording, examples for diversity-sensitive depiction and guidelines for events. Additional wording guides and gender lexicons are linked there as well.

Table 11: Good practice example based on the concrete measure, its description, the motivation behind it and the implementation. “Guidelines for the use of gender-appropriate and diversity-sensitive language”.

107 Dreas, Susanne; Rastetter, Daniela (2016): Die Entwicklung von Diversity Kompetenz als Veränderungsprozess. In: Genkova, Petia und Tobias Ringeisen (Publisher): Handbuch Diversity Kompetenz. Wiesbaden: Springer, S. 351–369.

108 See <https://www.quarks.de/gesellschaft/psychologie/was-gendern-bringt-und-was-nicht/> [Accessed on 14.10.2022]

109 Martin, Isabel; Weiler, Petra; Arnold-Triangeli, Linda (2021): Geschlechtergerechtigkeit und Diversität heben Potenziale. Published by VDI/VDE Innovation + Technik GmbH. Available at: https://www.ipcei-batteries.eu/fileadmin/Images/accompanying-research/publications/IPCEI_wB_BZF_Handreichung_Gender_Diversity_DE.pdf, accessed: 23.03.2023.

4.2.2 Evaluation of measures and their effects – spreading the word about diversity

Key findings

A company's public image is the first source of information for applicants. A diversity-sensitive public image and communication along with the presentation of evaluations of diversity measures addresses a larger circle of prospects and can avoid having certain target groups among job seekers feeling excluded.

The public image is an important aspect in to attract job seekers to the company, also from the perspective of diversity. Here it is crucial to externally communicate the efforts to establish diversity in the company and how this is valued internally. This is often an important criterion for job seekers in choosing a new employer.¹¹⁰ Once again, this must not be aimed at merely creating an external "legitimation façade", with inequalities and stereotypes continuing behind it. Instead the sincerity of the measures has to be apparent. Otherwise, there is a risk that successfully recruited employees will leave the company once they realise that the goal of valuing cultural diversity in the company is not consistently pursued (and, for example, utilising measures for work/family balance leads to negative assessments; see above).

Strategic HR management oriented towards (changing) needs and individual life circumstances of the employees, in conjunction with a company culture that promotes such diversity, can make a company more attractive for applicants and existing employees. This can result in higher application rates (and more diverse applicants) as well as reduced employee turnover (Federal Government 2022¹¹¹).

Evaluations: Generating, collecting and publishing data broken down by diversity dimensions as well as data on measures promoting diversity and their effects can help companies truly take the diversity objective seriously and incorporate it in their company culture. This information can also be used to communicate the company's commitment to diversity externally. Although, the effectiveness of diversity measures are often assumed, it is frequently not evaluated (quantitatively). Measuring success in terms of diversity is often challenging, which can make evaluating the effectiveness of diversity measures complex. Suggestions are however made in literature to render the success of diversity training, for example, measurable (see Chapter 7 and Dreas and Rastetter 2016). As shown in Section 3.3.1, regular evaluations of diversity aspects positively correlate with the proportion of women and age diversity in battery cell manufacturing companies. However, only nearly 37% of the surveyed companies reported conducting these evaluations.

¹¹⁰ <https://www.mckinsey.com/featured-insights/sustainable-inclusive-growth/chart-of-the-day/not-inclusive-youre-losing-39-percent-of-job-applicants> [Accessed on 24.03.2023]

¹¹¹ Federal Government (2022): Fachkräftestrategie der Bundesregierung. Published by Federal Ministry of Labour and Social Affairs. Berlin. Available at: https://www.bmas.de/SharedDocs/Downloads/DE/Publikationen/fachkraeftestrategie-der-bundesregierung.pdf?__blob=publicationFile&v=5, accessed: 17.10.2022.

Measure	Generate, collect and publish data broken down by diversity dimensions as well as data on measures promoting diversity and their effects
Description	The presentation and evaluation of diversity in the company and corresponding measures can help companies truly take the diversity objective seriously and incorporate it in their company culture. This information can also be used to communicate the company's commitment to diversity externally.
Motivation	A larger group of prospects can be addressed with a corresponding public image. Although the effectiveness of diversity measures are often assumed, it is frequently not evaluated (quantitatively). Measuring success in terms of diversity is often challenging, which can make evaluating the effectiveness of diversity measures complex.
Implementation	A possible approach is proposed in the literature as follows (Dreas and Rastetter 2016¹¹²): 1. Recording the reaction of participants in a measure: The satisfaction of participants in a measure can be recorded, for example, using written questionnaires with closed and open-ended questions. 2. Generated knowledge, skills and abilities: Participants can also be asked about the subjective and objective learning success through a before-and-after comparison or comparison with a control group that did not take part in the measure. 3. Application of the generated skills during work: To what extent a measure actually resulted in changed behaviour during day-to-day work can be determined, for example, through interviews with the participants and also their colleagues. However, behavioural changes are more difficult to measure so this is rarely done. 4. Performance at the company level: Performance figures, for instance regarding employee satisfaction or increased productivity, can measure a company's success. It is however challenging to determine to what extent the change in the performance figures was actually caused by the diversity measure being evaluated. While points 1 and 2 can be implemented relatively well, the implementation of points 3 and 4 is correspondingly more problematic since establishing causality between the measure, behaviour change and performance is difficult.

Table 12: Presentation of a good practice example based on the concrete measure, its description, the motivation behind it and the implementation. "Generate, collect and publish data broken down by diversity dimensions as well as data on measures promoting diversity and their effects".

¹¹² Dreas, Susanne; Rastetter, Daniela (2016): Die Entwicklung von Diversity Kompetenz als Veränderungsprozess. In: Genkova, Petia und Tobias Ringeisen (Publisher): Handbuch Diversity Kompetenz. Wiesbaden: Springer, S. 351–369.

Company engagement: Appealing company engagement can also contribute to a public image with a focus on an open, diversity-sensitive company culture that goes beyond mere lip service. This can include participation in occupational orientation events, e.g. “Girls’ Day”, active collaboration with networks and associations, and identifying job profiles and career paths in battery cell production.

Measure	Demonstrate company engagement through participation in events promoting diversity and collaborate with networks that promote diversity
Description	Engagement in networks and events that promote diversity is a way for companies to signal that they value diversity.
Motivation	Diversity events and networks provide opportunities for companies to showcase their activities, and connect with skilled workers and other companies. Especially at cross-industry events interest from a broad audience for the battery industry can be attracted. By taking part in events and participating in networks, companies actively demonstrate their value ship of diversity, sending a signal to employees and the public.
Implementa- tion	Companies can participate in various subject-specific or interdisciplinary events that promote diversity and contribute to networks: “Girls’ Day”¹¹³ is an example of a prominent event in the STEM fields. Companies present their focus of interest and provide students with practical insights into various occupations, contributing to a long-term occupational orientation. The STEM network “Komm, mach MINT” and its stakeholders aim to provide a realistic understanding of engineering and scientific occupations, while also promoting opportunities for women in these fields.¹¹⁴ Other networks such as “MINT-Regionen”, focuses on strengthening STEM education at regional level.¹¹⁵ In the “Charta der Vielfalt”¹¹⁶ hinterdisciplinary network, members have signed a self-commitment undertaking to promote and value diversity. The association assists companies with the implementation of diversity management and connects its members with each other and with partners.

Table 13: Presentation of a good practice example based on the concrete measure, its description, the motivation behind it and the implementation. “Demonstrate company engagement through participation in events promoting diversity and collaborate with networks that promote diversity”.

113 <https://www.girls-day.de/> [Accessed on 24.03.2023]

114 <https://www.komm-mach-mint.de/> [Accessed on 24.03.2023]

115 <https://www.mint-regionen.de/> [Accessed on 24.03.2023]

116 <https://www.charta-der-vielfalt.de/> [Accessed on 24.03.2023]

4.3 Diversity focus in personnel recruitment and retention

4.3.1 Recruiting

Key findings

Companies can successfully compete for and recruit new skilled workers when diversity is considered in the entire recruitment process – from target group sensitive communication to managing bias in the selection and decision-making process. This is of particular relevance for the battery industry. The industry's compound annual growth rate (CAGR) is 26% this decade. Competition for the best minds and hands is correspondingly fierce. Skilled talents are recruited around the world at considerable cost. Successful recruitment is one of the most important factors that will decide the success of aspiring companies in the battery industry.

In a PageGroup study, 69% of the respondents identified restructuring of recruitment processes as one of the most important diversity management measures (PageGroup 2021¹¹⁷). All recruitment concepts and tools in this context should be free of discrimination and bias (Berger and Dietz 2016¹¹⁸).

Job advertisements are a key interface between companies and job seekers, allowing skilled talents to determine whether the future job and position matches their personal identity, and whether they can meet the stated requirements (Brandl 2015¹¹⁹). Unconscious bias in the wording of tasks and requirement profiles influences the application behaviour of under-represented groups. This refers, for example, to stereotypes or assumptions about women and men that are unconsciously internalised by people and that influence language. As a result, not all people may feel equally addressed due to certain wording and the use of some gender-specific attributes in job advertisements. Some terminology tends to be associated with women or men, respectively, while other terms are not perceived as gender-specific (Risius et al. 2019¹²⁰).

According to a study, wording associated with a male or female stereotype influences the application behaviour. Specifically, the study found that female job seekers were less interested in requirements with male connotation, while requirements with a female connotation sparked greater applicant interest. There was no evidence that men are deterred by wording with a female connotation (Brandl 2015; Appleby and Brandl 2015¹²¹). A study over half a million job descriptions on StepStone.de from December 2020 and May 2021 revealed that 96% contained gender-specific wording – and considerably more male than female.¹²² In the battery industry, where there is a labour shortage, addressing all groups in job advertisements is especially important. The time from publishing a job advertisement until the position is filled indicates a corresponding need for action.

117 PageGroup (Publisher) (2021): Diversity Management Studie 2021.

118 Berger, Sarah; Dietz, Annette (2016): Handlungsempfehlung Vielfalt im Unternehmen / Diversity Management. Published by Institut der deutschen Wirtschaft Köln e.V. Köln. Available at: <https://www.kofa.de/media/Publikationen/Handlungsempfehlungen/DiversityManagement.pdf>, accessed: 14.10.2022.

119 Brandl, Julia (2015): Die Macht der Worte- Stellenanzeigen als Instrument zur Diversitätsförderung. In: Austrian Management Review 5, p. 100–108. DOI: 10.1007/978-3-642-39152-1_3.

120 Risius, Paula; Blazek, Zuzana; Schopen, Anna; Stippler, Sibylle; Brinkmann, Sabine; Reifenröther, Elena et al. (2019): Mit Stellenanzeigen gezielt weibliche Fachkräfte gewinnen. Published by Institut der deutschen Wirtschaft Köln e.V. Available at: https://www.kofa.de/media/Publikationen/Handlungsempfehlungen/Rekrutierung_Frauen.pdf.

121 Brandl, Julia (2015): Die Macht der Worte- Stellenanzeigen als Instrument zur Diversitätsförderung. In: Austrian Management Review 5, p. 100–108. DOI: 10.1007/978-3-642-39152-1_3.

122 <https://www.stepstone.de/Ueber-StepStone/press/jede-zweite-stellenanzeige-hat-mannlichen-bias/> [Accessed on: 24.03.2023]

Objective job advertisement: Women also tend to be more self-critical than men with regard to occupational requirements. This, combined with job advertisements that use biased language, can result in women being discouraged from applying for positions. In fact, 85% of all job seekers in a StepStone study indicated that they have decided against applying in the past because they did not feel that the word-

ing appealed to them.¹²³ To address potential biases and increase inclusivity, it is recommended that *job advertisements be reviewed for unwanted bias and wording requirements objectively and neutrally*. As described in Section 3.3.1, the majority of battery companies (84%) said the wording of their job advertisements is diversity-sensitive in a way that goes beyond of legal requirements.

Measure	Diversity-oriented recruitment process – starting with an objective job advertisement
Description	The objective of a diverse workforce is considered during the entire recruitment process. That starts with an objective job advertisement. Questions to review this include: Do the contents of the advertisement reflect the requirements for the position, or do they cater to a specific type of person? Has the advertisement been widely disseminated to reach a diverse pool of potential applicants? What is the company's external image and does this appeal to a diverse target group? (Federal Anti-Discrimination Agency 2019 ¹²⁴)
Motivation	The use of diversity-aware language and image avoids unconscious exclusion mechanisms and discrimination in job advertisements. By equally addressing all groups of people, job advertisements can appeal to a larger and more diverse pool of applicants.
Implementation	The General Act on Equal Treatment (AGG) serves to protect against discrimination in job advertisements. Therefore, job advertisements are not permitted to disadvantage applicants based on ethnicity, gender, religion or ideology, disability, age or sexual identity, nor to contain any corresponding wording (Federal Anti-Discrimination Agency 2018 ¹²⁵). Research shows that the majority of job advertisements that were reviewed do not exhibit any discrimination in terms of the AGG. On the other hand, wording that poses a risk of discrimination is more common (for example, requirement for fluency in German or photos that only depict men) (Federal Anti-Discrimination Agency 2018 ¹²⁶). Thus it is important to exclude such risk of discrimination in order to address diverse groups of people. This includes using inclusive language and choosing images that showcase diversity in terms of race, gender, age and other diversity dimensions. When creating job advertisements companies can also go beyond legal requirements and actively promote diversity.

Table 14: Presentation of a good practice example based on the concrete measure, its description, the motivation behind it and the implementation. "Diversity-oriented recruitment process – starting with an objective job advertisement".

123 <https://www.stepstone.de/Ueber-StepStone/press/jede-zweite-stellenanzeige-hat-mannlichen-bias/> [Accessed on: 24.03.2023]

124 Federal Anti-Discrimination Agency (2019): Fair in den Job! Leitfaden für diskriminierungsfreie Einstellungsverfahren. Published by Federal Anti-Discrimination Agency. Berlin. Available at: https://www.antidiskriminierungsstelle.de/SharedDocs/downloads/DE/publikationen/Leitfaeden/leitfaden_fair_in_den_job.pdf;jsessionid=37316C468C41BEA7D1759C215CFE5A1B.intranet222?__blob=publicationFile&v=3, accessed: 14.10.2022.

125 Federal Anti-Discrimination Agency (2018): Diskriminierung in Stellenanzeigen. Studie zur Auswertung von Stellenanzeigen im Hinblick auf Diskriminierung, Ausschlussmechanismen und positive Maßnahmen. Published by Federal Anti-Discrimination Agency. Berlin. Available at: https://www.antidiskriminierungsstelle.de/SharedDocs/downloads/DE/publikationen/Expertisen/diskriminierung_in_stellenanzeigen.pdf?__blob=publicationFile&v=3, accessed: 13.10.2022.

126 Federal Anti-Discrimination Agency (2018): Diskriminierung in Stellenanzeigen. Studie zur Auswertung von Stellenanzeigen im Hinblick auf Diskriminierung, Ausschlussmechanismen und positive Maßnahmen. Published by Federal Anti-Discrimination Agency. Berlin. Available at: https://www.antidiskriminierungsstelle.de/SharedDocs/downloads/DE/publikationen/Expertisen/diskriminierung_in_stellenanzeigen.pdf?__blob=publicationFile&v=3, accessed: 13.10.2022.

Target group-specific recruitment: Two types of leverage exist for particular, target group-specific recruitment. One, the *significance of diversity in employee selection and promotion* can be emphasised and two, *discriminating against groups of people should be avoided* (Brandl 2015¹²⁷). This can be realised, for example, through transparent communication of the personnel selection and promotion procedure. Photos of the employment context can visually support the job advertisement or the career and job pages and give the company a face. Using images of diverse groups of people highlights a company's openness to them. Excluding groups of people can be avoided, for example, with the gender-neutral wording of job titles. In any case, the requirements of the General Act on Equal Treatment (AGG)¹²⁸ should be complied with. Positive wording intended to encourage under-represented groups of people in particular to apply is always possible.¹²⁹ Against the background that women are under-represented in the battery sector being considered here (see Section 3.1.1.), addressing them specifically is recommended in order to expand the pool of applicants.

Applicants with the best qualifications for the job should have the best chances of an interview in the selection process. Not only evaluating the qualifications in the formal sense is worthwhile here. Experience and special soft skills are also valuable (Berger and Dietz 2016¹³⁰). On the other hand, unconscious biases can lead to systematic discrimination against certain groups of people. Various studies reveal discrimination against applicants with a migration background compared to those without (Koopmans et al. 2018¹³¹). For example, people with foreign names (when all other factors are equal) were less frequently invited to interviews than people with German names (Schneider et al. 2014¹³²). One solution is to use *anonymised application processes* in which data and information about personality traits are removed for the initial review to help prevent this phenomenon.

Boosting awareness of subconscious exclusion mechanisms can minimise the leeway for such unconscious biases.¹³³ *Objective and transparent decision-making processes* for the selection procedure can counteract this as well. The interview plays a central role in the hiring process and careful preparation helps ensure that only relevant questions to review qualifications are asked. *Standardised procedures* can also help avoid unwanted discrimination. To establish a diverse workforce, companies can aim for a *balanced ratio* between represented and under-represented groups of people in hiring decisions. Equal hiring is conceivable as well: Accordingly, applicants who are members of a minority group are preferred when qualifications are equal (PageGroup 2021¹³⁴).

127 Brandl, Julia (2015): Die Macht der Worte- Stellenanzeigen als Instrument zur Diversitätsförderung. In: Austrian Management Review 5, p. 100–108. DOI: 10.1007/978-3-642-39152-1_3.

128 See <https://www.gesetze-im-internet.de/agg/> [Accessed on 24.03.2023]

129 Wording guidelines and explanations are available at the German Federal Anti-Discrimination Agency 2019.

130 Berger, Sarah; Dietz, Annette (2016): Handlungsempfehlung Vielfalt im Unternehmen / Diversity Management. Published by Institut der deutschen Wirtschaft Köln e.V. Köln. Available at: <https://www.kofa.de/media/Publikationen/Handlungsempfehlungen/DiversityManagement.pdf>, accessed: 14.10.2022.

131 Koopmans, Ruud; Veit, Susanne; Yemane, Ruta (2018): Ethnische Hierarchien in der Bewerberauswahl: Ein Feldexperiment zu den Ursachen von Arbeitsmarktdiskriminierung. Discussion Paper SP VI 2018-104. Published by WZB. Berlin. Available at: <https://bibliothek.wzb.eu/pdf/2018/vi18-104.pdf>, accessed: 04.08.2022.

132 Schneider, Jan; Yemane, Ruta; Weinmann, Martin (2014): Diskriminierung am Ausbildungsmarkt. Ausmaß, Ursachen und Handlungsperspektiven. Published by Forschungsbereich beim Sachverständigenrat deutscher Stiftungen für Integration und Migration (SVR). Berlin. Available at: <https://d-nb.info/1054103348/34>, accessed: 04.08.2022.

133 34% of the employees surveyed in a study stated that programmes that help identify unconscious biases and/or systematic obstacles to equality in other work areas as well constitute one of the most important measures of a diversity strategy; see Dynata 2021, S. 10.

134 PageGroup (Publisher) (2021): Diversity Management Studie 2021.

4.3.2 Recruiting skilled talents from abroad

According to Batteries Europe, sufficient specialised knowledge for the mass production of batteries and for the overall battery value chain does not yet exist in Germany and Europe (Dominko et al. 2020¹³⁵). Since these competencies are however found in Asia, recruiting skilled workers from Asia is considered essential at this time (Dominko et al. 2020¹³⁶). That may explain the proportion of foreign nationals in the sector “Manufacture of batteries and accumulators”. Especially among full-time employees, this increased considerably in 2020 and 2021 (see Section 3.1.1). According to the Global Energy Talent Index (GETI) 2022, the starting position for recruitment from abroad remains favourable. The report states that 86% of the respondents would consider relocating internationally in the next three years. Europe at 33% remains the most attractive destination for international relocation. This reflects Europe’s worldwide leadership role in the global energy revolution (Brabec et al. 2022¹³⁷). According to the GETI report, only 25% of the respondents indicated they receive relocation assistance within the framework of their employment relationship. Given the competition for skilled workers in the battery industry, employers can improve their chances of recruiting these skilled workers by offering relocation assistance. Aside from help with moving to a new home, this includes assistance with finding child care and educational facilities, flexible working hours, time off for bureaucratic matters and the financing of language courses. Finally, the company culture needs to be welcoming for the integration and appreciation of skilled talents from abroad. The recommendations for a diversity-friendly company culture (see Section 4.2) and diversity-sensitive management (see Section 4.1) also apply in order to realise this.

4.3.3 Occupational career paths

Key findings

Designing occupational development and continuing education with a focus on diversity allows for all employee groups throughout all company departments to be addressed, and helps to close gaps and avoid biases. “Micropolitical competence” mentoring programmes and coaching can improve the career opportunities in the company for under-represented employee groups. Communication should always be at eye level with a corresponding openness to alternative, flexible career paths. This considerably boosts equal opportunities in the company and thus employee satisfaction and productivity. The long-term retention of skilled workers in the company is improved as a result. This is particularly important for companies in the battery industry since the competition for skilled workers is unusually tough and the costs for recruitment are high. Additionally, employee retention can help prevent the loss of valuable know-how and experience.

The longer the career path in the company, the lower the proportion of women and other groups disadvantaged in the labour market will generally be. As evidenced by the figures in Section 3.1.1 regarding managers and also the gender pay gap, battery cell manufacturing is no exception in this regard. This phenomenon is also known as the “glass ceiling” (Cotter et al. 2001¹³⁸). It means that obstacles appear during the career that can make advancement more difficult. These include, for example, exclusion from networks that support advancement as well as a lack of options for work-life balance and flexibility. “Statistical discrimination” (Phelps 1972¹³⁹) – meaning systematic discrimination in filling leadership positions based on generalisations in the evaluation of competencies – can also impede the advancement of women and other groups disadvantaged in the labour market.

135 Dominko, Robert; Maleka, Dimitra; Thielmann, Axel (2020): Education and Skills Position Paper. Available at: https://ec.europa.eu/energy/system/files/documents/education_and_skills_task_force_position_paper.pdf.

136 Dominko, Robert; Maleka, Dimitra; Thielmann, Axel (2020): Education and Skills Position Paper. Available at: https://ec.europa.eu/energy/system/files/documents/education_and_skills_task_force_position_paper.pdf.

137 Brabec, Steven; Bruyn, Leon de; MacAuley, Marx, Janette; Fiona; McAllister, Kathleen; Schmidtke Johanna; Young, Josh (2022): The Global Energy Talent Index Report. Published by Airswift.

138 Cotter, David A.; Hermesen, Joan M.; Ovadia, Seth; Vanneman, Reeve (2001): The Glass Ceiling Effect. In: *Social Forces* 80 (2), p. 655–681.

139 Phelps, Edmund S. (1972): The Statistical Theory of Racism and Sexism. In: *The American Economic Review* 62 (4), p. 659–661.

Statistical discrimination theory

The theory of statistical discrimination is based on incomplete information of employers regarding the true productivity of (potential) employees. Thus they determine the (seemingly) expected productivity. Consequently, members of a group with lower average productivity in the labour market are not hired, or only with lower earnings, and are offered fewer opportunities for continuing education and advancement (since women, for example, interrupt or reduce their gainful employment more often on average due to family demands, their productivity appears lower on average).¹⁴⁰

Achieving equal work conditions requires measures that raise awareness, uncover and eliminate unequal treatment. Alongside this, openness to alternative and flexible career paths should be established to move beyond the status quo of traditional careers and full-time employees continuously available to the employer. Possible approaches include *mentoring and the visibility of role models*. *Clearly outlined earnings and development opportunities* also play an important role in terms of *transparent and comprehensible provisions and processes*, regardless of personal preferences of superiors or homogeneous networks (“old boy networks”) (Wittpahl et al. 2020¹⁴¹).

For employers to advance their careers within a company, they must understand the internal “rules” embedded in the company culture. This is also known as “*micropolitical competency*”. Empirical results show that knowing and strategically employing these rules can positively impact career success, and that *coaching in micropolitical competency* can be beneficial on the occupational success of women (Cornils et al. 2012¹⁴²). However, it should be noted that such measures can lead to, mere adapting to traditionally male-dominated realities of life and work when the described collective rules are aligned with male environments. In the battery cell manufacturing industry, where men make up a disproportionate number of the employees, it is important to prioritise diversity by remaining open to other perspectives and cultures. Communication at eye level rather than merely adapting to the status quo are key to achieving lasting changes.

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5 CONCLUSION

In light of the tense labour market situation for the German battery industry, this study reveals untapped potential for a skilled workforce based on quantitative data (see Section 3). Companies need to position themselves as attractive employers in order to meet the current and future demand for skilled workers and to prepare themselves for the competition for talents. Embracing diversity can help companies to master the challenges concerning their personnel and offer various advantages over competitors (see Section 2). When companies value diversity they are able to attract a larger number of potential talents from various backgrounds.

Battery cell manufacturing has favourable conditions for diversity: According to evaluations of data from the German Federal Employment Agency for the year 2021, the proportion of women in the battery production sector was observed to be 24%, which is lower in comparison to the labour market as a whole, but higher compared to STEM occupations in general. The industry also appears to offer special incentives for foreign nationals, who accounted for 73% of the increase in personnel between 2020 and 2021. There is a gender pay gap observed in this industry sector at 18%, which resembles the one observed for overall German labour market (see Section 3.1). Companies should take steps to make this sector more attractive for women with regard to earnings and opportunities for career advancement. Good work conditions in leadership positions (for instance regarding work/family balance) should be promoted to obtain a competitive edge in attracting skilled workers. Naturally, skilled workers of interest for the battery value chain industry are mainly coming from STEM education. Measured by the proportion of students in occupational training and university studies, graduates in the disciplines of mechanics and natural sciences (occupational training) and materials/material sciences (university studies) are of interest for battery cell manufacturing. Based on a comparison of the current figures with modelling (see Section 3.2) the academic occupations that are of interest for the battery cell manufacturing show above-average proportion of women and foreign nationals.

Section 4 provides a description of general conditions, recommendations and concrete measures for implementing diversity management. An overview of the described measures and their effects on the recruitment and retention of talents are presented at the beginning of the section. Three aspects are crucial for successful diversity measures: raising awareness, accountability and repetition, while simultaneously imparting diversity-oriented competencies in management development. To tap into the full potential of diversity, it is important to incorporate diversity into the company culture and internal processes and to have company management and managers actively promote diversity. When the prevailing company culture is more traditional, greater accountability helps with the implementation of measures. Positive experiences with diversity and participative processes contribute to the acceptance of diversity and alternative aspirations and can facilitate to transform the company culture.

The findings of this study may have significant implications for the battery industry. In particular, decision makers in companies can make use of the provided qualitative and quantitative arguments to legitimise the promotion of diversity in their company as an essential and meaningful step to address the shortage of skilled talents. In this context, the study emphasises that certain general conditions are base requirements for a successful implementation of diversity ensuring the desired results in the long term. By presenting and analysing the status quo of employees in the sector “Manufacture of batteries and accumulators”, the study provides a basis for the industry to identify spheres of activity and unrealised potential. The results of this study provide as well a benchmark system for companies to evaluate their own diversity in comparison to other companies. Finally, the study offers concrete recommendations and measures to realise the potential of diversity in companies. These recommendations may support battery industry companies to maintain a competitive edge in securing the supply of skilled workers.

This study provides insights into the diversity dimensions “gender”, “nationality” and “age diversity” from various perspectives. It is, however, important to mention that due to limited responses in the conducted survey, this study was primarily restricted to these three dimensions, which also affected the depth of data analysis. In particular, no data were available for the third gender and ethnicity of the employees. Furthermore, considering additional diversity dimensions and their cross-relations as well as relevant third variables (for instance, for a more in-depth investigation of the gender pay gap) would have considerably expanded the variable-space and scope of the study. Further research is therefore recommended to examine additional diversity dimensions and multivariate models in order to expand this field of research into the battery industry. The study mainly focused on processing and evaluating quantitative data, which limited the generation of qualitative findings, which had a limiting influence on the study results. Hence, it is recommended to conduct qualitative research on diversity in the battery industry to complement the quantitative findings of this study.

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TABLE OF FIGURES

Figure 1: Status quo on diversity in the sector “Manufacture of batteries and accumulators” in 2021; source: Special statistical analysis of the German Federal Employment Agency; in-house representation.	4
Figure 2: Dimensions of diversity based on Gardenswartz and Rowe (Diverse Teams at Work (2nd Edition, SHRM, 2003)); in-house representation.	8
Figure 3: Proportion of women and foreign nationals in full-time and part-time employment, 2020 and 2021 in percent (Economic Activity (WZ): “Manufacture of batteries and accumulators”).	11
Figure 4: Full-time/part-time employment of women, men and foreign nationals, 2020 and 2021 in percent (WZ: “Manufacture of batteries and accumulators”).	12
Figure 5: Proportion of women within the foreign nationals group by full-time/part-time employment, 2020 and 2021 in percent (WZ: “Manufacture of batteries and accumulators”).	13
Figure 6: Qualification of women, men and foreign nationals, 2021 in percent (WZ: “Manufacture of batteries and accumulators”).	15
Figure 7: Proportion of women and foreign nationals out of employees, according to qualification, 2021 in percent (WZ: “Manufacture of batteries and accumulators”).	16
Figure 8: Qualification within the foreign nationals group by gender, 2021 in percent (WZ: “Manufacture of batteries and accumulators”).	16
Figure 9: Proportion of women within the foreign nationals group by qualification, 2021 in percent (WZ: “Manufacture of batteries and accumulators”).	17
Figure 10: Proportion of women and foreign nationals out of employees in leadership positions, 2021 in percent (WZ: “Manufacture of batteries and accumulators”).	18
Figure 11: Occupational status of women, men and foreign nationals, 2021 in percent (WZ: “Manufacture of batteries and accumulators”).	19
Figure 12: Proportion of women within the foreign nationals group by leadership positions, 2021 in percent (WZ: “Manufacture of batteries and accumulators”).	19
Figure 13: Proportion of employees by age groups in years, 2021 in percent (WZ: “Manufacture of batteries and accumulators”).	20
Figure 14: Proportion of employees by age groups in years and by gender, 2021 in (WZ: “Manufacture of batteries and accumulators”).	20
Figure 15: Gender pay gap in percent and average gross monthly earnings (medians); source: special analysis of employment statistics, in-house representation.	22
Figure 16: Internal dimension of diversity based on Gardenswartz and Rowe (Diverse Teams at Work (2nd Edition, SHRM, 2003)), in-house representation.	25

Figure 17: Demand for skilled workers in general in battery value chain (in Europe) in 2020-2035, in-house representation. The respective min./max. values are presented. The proportions of the different areas (upstream, battery production and battery cell production) were taken from the Fraunhofer study (Thielmann et al. 2021). 27

Figure 18: Composition of production staff in cell manufacturing, in-house representation. Extrapolation of workers required in Germany in the various battery cell manufacturing job roles until 2033 (values rounded to highlight the order of magnitude). 28

Figure 19: Summary of skilled workers needed in Germany for the production staff and R&D in battery cell manufacturing between 2020 and 2033; in-house representation. The skilled occupations are shown on the left and the academic occupations on the right. Their maximum (max.) and average annual ($\emptyset$) demands are given as numeric values. The proportion of the average annual demand ($\emptyset$) out of the respective new registered for vocational training (in 2020) and new registrations for academic studies (in the 2020/21 winter semester), respectively, are visualised as bars for the minimum (light) and maximum (dark) demand. 29

Figure 20: Comparison of the data from the statistics of the German Federal Employment Agency for the Economic Activity 272 “Manufacture of batteries and accumulators” (outer circle diagram, the item 3.1% “not applicable” was excluded from the examination) and the data from this study modelled on this basis (inner circle diagram); in-house representation. 30

Figure 21: Qualitative representation of data collection, recording and preparation. Jobs from the Northvolt job portal for the Northvolt Ett plant were analysed by job roles, skilled occupations and academic occupations, and assigned to the corresponding production departments; in-house representation. 31

Figure 22: (Left) Relationship between required personnel, maximum (red marking) and minimum (blue marking) per GWh of production in the years 2020 to 2030 (Thielmann et al. 2021). The data can be described with a linear function. (Right) Relationship between the projected production capacity in Europe in the years 2020 to 2030 (Heimes 2022). These data can be described with a second-degree polynomial. 33

Figure 23: Composition of production staff in a battery manufacturing company; in-house representation. (Left) The symbols respectively represent a job role, which is broken down into academic occupations and skilled occupations or no professional qualification. (Right) The ratios of the number of different job roles (in and outside shift work) in three production departments (production in the line, quality and production/process technology) are shown. Manager merely refers to a person as department manager here (more detailed structuring would involve excessive speculation). Thus a direct quantitative relation to the remaining job roles in the respective department cannot be drawn from this. (Above) This describes the proportion of employees in the departments examined in this study (directly involved in production, i.e. excluding R&D, administration etc.) in comparison to the total number of employees in all of these departments together. 34

Figure 24: In-house representation of the modelling assumptions. The distribution of staff in an average battery cell manufacturing plant was assumed with 15% in administration, 15% in R&D and 70% in production. Academic occupations (green figures) were assumed in all three categories, skilled occupations, semi-skilled workers and trainees (blue figures) in the administration and production departments. The trainee proportion of 4.8% was assumed in the respective departments (administration and production) in reference to the total number of employees in the respective department. An assumed composition of the R&D department by academic occupations was described in percentages. In the administration department, the ratio of employees with academic occupations to skilled occupations was assumed to be one to two. See the text for references. 35

Figure 25: Summary of diversity measures implemented in the surveyed companies in 2022. (Source: Online survey 2022, VDI-VDE-IT, in-house representation)..... 38

Figure 26: Overview of measures and their effects for the recruitment and retention of talents based on the key aspects of leadership, company culture, recruitment and career; in-house representation..... 43

LIST OF TABLES

Table 1: Variables and number of cases included for 2020 for the sector “Manufacture of batteries and accumulators”.	22
Table 2: Variables and number of cases included for 2021 for the sector “Manufacture of batteries and accumulators”.	23
Table 3: Quantitative description of the recorded and prepared data from Figure 21. Listing of the proportion of naming of academic and skilled occupations in job advertisements for the respective production departments.....	32
Table 4: Proportion of women, foreign nationals, and age diversity (as described above, represented by the standard deviation of the average proportion for the six age categories examined in this study) in the surveyed companies in 2022.	37
Table 5: Proportion of women and age diversity in the surveyed companies linked to implemented diversity measure in 2022: Do you perform regular analyses of diversity aspects?	38
Table 6: Proportion of women and age diversity in the surveyed companies linked to implemented diversity measure in 2022: Do you regularly conduct employee surveys to determine whether employee diversity is recognised and valued?	39
Table 7: Proportion of women and age diversity in the surveyed companies linked to implemented diversity measure in 2022: Has company management committed to promoting diversity?	39
Table 8: Proportion of women and age diversity in the surveyed companies linked to implemented diversity measure in 2022: Does your company have a mission statement for the promotion of diversity?	39
Table 9: Good practice example based on the concrete measure, its description, the motivation behind it and the implementation. “Implement binding work-life/family balance and workplace flexibility measures”.....	49
Table 10: Good practice example based on the concrete measure, its description, the motivation behind it and the implementation. “Company management makes a commitment to promoting diversity”.	51
Table 11: Good practice example based on the concrete measure, its description, the motivation behind it and the implementation. “Guidelines for the use of gender-appropriate and diversity-sensitive language”.	52
Table 12: Presentation of a good practice example based on the concrete measure, its description, the motivation behind it and the implementation. “Generate, collect and publish data broken down by diversity dimensions as well as data on measures promoting diversity and their effects”.....	54
Table 13: Presentation of a good practice example based on the concrete measure, its description, the motivation behind it and the implementation. “Demonstrate company engagement through participation in events promoting diversity and collaborate with networks that promote diversity”.	55
Table 14: Presentation of a good practice example based on the concrete measure, its description, the motivation behind it and the implementation. “Diversity-oriented recruitment process – starting with an objective job advertisement”.....	57

LIST OF ABBREVIATIONS

AGG	German General Act on Equal Treatment („Allgemeines Gleichbehandlungsgesetz“)
BA	German Federal Employment Agency (“Bundesagentur für Arbeit“)
CAGR	Compound Annual Growth Rate
GETI	Global Energy Talent Report
GWh	Gigawatt hour
KldB 2010	Occupational classification of the German Federal Statistical Office 2010
SGB III	Social Security Code, Book Three (“Sozialgesetzbuch Drittes Buch“)
WZ	Economic Activity (“Wirtschaftszweig“)

