16 More seats at the table: Participation and inclusivity in German innovation

This chapter considers issues of inclusion in the science, technology and innovation (STI) system. While Germany's STI system is strong, it nevertheless faces a number of inclusion challenges, particularly along gender lines. The chapter introduces these challenges, and also discusses aspects of territorial and industrial inclusion. The potentially uneven impact of the sustainable and digital transformations makes it more important than ever to ensure a broader range of voices are heard in the policymaking and policy implementation process. To this end, the chapter presents a recommendation on more participatory policymaking for STI in transitions.

Introduction

Inclusivity is important to innovation. Who takes part in innovation has consequences for who benefits from the productivity and income gains engendered by such innovation. The reverse is also true: those marginalised from innovation activities may be negatively affected by the socio-economic changes that benefit others. Inclusivity results in STI policy that better reflects socio-economic goals. Considering a greater range of voices during decision-making – including those that do not traditionally participate in the science, technology and innovation (STI) system – can produce better-informed and more effective public interventions that enjoy a higher level of social buy-in and mitigate resistance to change.

Beyond these direct impacts, both the geographic distribution of innovation activities and their industrial composition also affect inclusion. When the geographic dispersion of innovation and innovative capacities is low, the opportunities for individuals across the geography will differ. In industry, the allocation of innovation resources and capacities between firms, and the sectors in which they operate, affect inclusivity as they determine differences in salaries and returns on capital. Both questions therefore relate to the challenge of social inclusion, since they imply an uneven distribution of the gains from innovative performance and the ability to participate in innovation.

Despite the general strengths of Germany's innovation system, several inclusivity challenges affect innovation. As discussed in Chapters 3, 10 and 11, private-sector innovation activities are overwhelmingly concentrated within large firms, with a comparatively small contribution of small and medium-sized enterprises (SMEs). While this section does not focus on these industrial issues, they are nonetheless related to the challenges discussed here. For example, the industrial concentration of innovation and innovative sectors has a territorial dimension, with a handful of regions accounting for the bulk of innovation output. As a result, as some regions have become world leaders in certain technology fields, capacities in other regions have lagged, contributing to an interregional inequality. Similar inclusivity challenges are mapped along gender lines. Again, due to the industrial focus of German innovation, the private sector has historically favoured science, technology, engineering and mathematics (STEM) skills, a domain where women continue to be under-represented. These combined inclusion challenges mean not only that the country has missed out on input from under-represented groups, but that the capabilities in the innovation system – for example, in skills outside of STEM that are more readily held by women or migrants – may be insufficient to meet the innovation needs of the sustainability and digital transitions.

While the sustainable transition aims in particular for a greener, fairer and more sustainable economy, the innovation that will achieve this can – at least in the medium term – have asymmetrical socio-economic impacts. For example, the transition to renewable energy will create new jobs, investment opportunities and wealth, but it will also involve shutting down Germany's coal mines and hence a loss of employment. Similarly, the "winner-takes-all' and disruptive dynamics that sometimes accompany digital innovation can lead to further concentration of the actors who can participate in and benefit from these innovation gains (unlike the relatively broad base of participation in industrial innovation). Managing these socio-economic impacts of innovation – particularly where they map along existing territorial, industrial, socio-demographic and gender-inclusion divides – will be key to ensure that the success of STI in supporting transitions delivers an equitable settlement for society.

Policy responses to these inclusiveness challenges vary, but their core goal is tackling the misallocation of resources in the economy caused by exclusion. In correcting that misallocation, policy makers can broaden the range of contributors to innovation, and even STI policy making, thereby supporting inclusive economic growth and job creation. Regarding participation in innovation, this means addressing capacities to innovate, from primary to tertiary education and reskilling programmes; reducing barriers to innovation facing firms and citizens; promoting more collaborative forms of innovation; and mitigating the territorially and industrially uneven allocation of capacities and opportunities. In terms of policy making, this means bringing more people to the table when setting priorities and making decisions; instituting more collaborative policy making between society and the STI system; and learning from local experience in approaches to STI.

This section focuses on territorial and social inclusiveness challenges in the German STI system. The section begins with a recommendation on improving social inclusion and the decision-making process in the STI system. It then presents an overview of inclusion challenges in the STI system. It concludes with a discussion of the opportunities offered by open science to expand contributions to the innovation system.

Recommendation 8: Increase the involvement of civil society and key stakeholders in STI policy for transitions

Overview and detailed recommendations

Many of the economic and technological challenges facing Germany have asymmetrical, often significant consequences, with societal impacts . The debates around ethics in the use of artificial intelligence (AI) tools and gene editing illustrate such impacts. STI policy making, therefore, should further include civil society in STI, ensuring that government policy and direction reflect the concerns and ideas of a broad range of actors. Broader civil-society engagement would also increase the *supply* of policy ideas and provide testbeds for experimentation, including especially at the city or municipal level. Participation of diverse social groups in innovation activities will also promote wider societal involvement, aside from helping to introduce transitions. Moreover, engaging civil society and STI stakeholders in a dialogue on the best ways to design STI policy programmes targeting or impacting them has important benefits. Such participation can improve diversity in participation and boost programme quality by incorporating the potential difficulties the intended beneficiaries may experience in engaging with those programmes.

R8.1 **Create citizen councils to debate innovation and innovation policy**. These councils could be formally linked to the forum proposed in R1, thereby providing structured input into STI policy making and direction. The citizen councils' discussions could centre on the same thematic agenda as the forum's. Testing policies and defining innovation challenges could also be elements of such exchanges.

R8.2 **Develop "city innovation laboratories"**. The government should consider developing of city laboratories where municipal authorities would have the autonomy to test new approaches to innovation policy. These approaches could take the form of public-private partnerships; partnerships with research institutions or start-ups; and procurement from innovative firms to address local issues linked to transitional challenges, such as electric mobility. City laboratories could provide real-world testbeds for bottom-up and entrepreneurial-driven innovation targeting a range of complex challenges, and serve as a springboard for scaling successful approaches at the state or national level. As an additional advantage, they would provide a more direct and responsive line of communication between STI policy makers at the national and local levels, which could significantly improve policy responsiveness and agility.

R8.3 **Create a policy programme that allows cities or municipalities to apply for special status that grants regulatory flexibility for innovative experimentation**. Allowing local authorities to apply for special status would streamline and accelerate bottom-up innovation as they could create more responsively the conditions conducive to innovation for local firms and better utilise these innovative capacities to solve place-specific challenges. Such localised approaches could encourage the emergence of regional leaders in a range of areas, including policy agility and co-ordination, public-sector digitalisation, innovative procurement, innovation for sustainability, innovation missions, citizen science and innovation, and social innovation.

R8.4 **Use co-creation programmes for innovation at the city and regional levels.** Local co-creation could be especially useful in encouraging innovative public procurement and open innovation systems, such as living labs, regulatory testbeds, and hackathons. Co-creation between the public and private sectors in particular could help de-risk innovation investment in emerging areas of technology for both parties. Sustainable mobility activities in cities are an important example of where innovation activities could benefit from local co-creation.

R8.5 **Boost diversity in the innovation system.** Engaging a more diverse set of actors will support diversity and inclusion, but it can also help improve the quality of innovation. In the context of an ageing society, attracting and involving skilled migrants, women, minorities and individuals from disadvantaged socio-economic backgrounds in innovation training and careers will be essential to ensure the innovation system has the talent it needs to succeed. Unequal representation of women, minorities and individuals from disadvantaged socio-economic backgrounds at senior levels of management could therefore be a source of weakness for the German private sector. The need for new skills – soft as well as technical –for success in the context of the sustainable and digital transitions also means that STEM skills that predominate in corporate boardrooms and leading innovation may pose a challenge for the future and also reduce inclusivity. Women tend to be more represented in these fields than STEM fields, and therefore supporting more those innovations could both bring more women into the innovation system in addition to improving Germany's innovative output in an area where it is comparably weaker. Widening the support for innovation could potentially also increase diversity beyond gender. Importantly, boosting about diversity needs to be also about diversity in the management and steering of innovation activities and not only about participation. Supporting citizen science and innovation activities are also important, as is involving civil society in knowledge co-creation activities.

Relevant global experience

Important examples of approaches to increasing the inclusion of people in STI policy making include collaborative innovation, participatory policy making and open science initiatives. When enacted successfully, each of these approaches has the dual effect of supporting *better* innovation outcomes (insofar as it promotes the type of multidisciplinary and cross-sectoral knowledge, as discussed in this report, that drives success in the transitional context), as well as social buy-in for these innovative outputs and the decision-making that led to them.

The importance of collaborative STI was clear during the COVID-19 pandemic: co-creation between innovation actors helped design solutions to diverse and challenging problems including vaccine development, ventilator manufacturing, and real-time data processing underpinning evidence-based policy interventions. In this sense, the pandemic highlighted that co-creation in STI can be a driver for innovation in both the public and private sectors. Another important dimension for co-creation that is relevant to Germany is the importance of relying on existing research institutions and promoting interactions with industry. For example, Canada's Pandemic Response Challenge relied on the National Research Council's established collaborative research and development (R&D) platform, as well as networks supported with grants and funding, to assemble collaborative teams for the COVID-19 response. Similarly, Chile's Scientific Research Fund *(Fondo de Investigación Científica*) is an existing programme led by the research development agency (ANID) and funded by the Government Ministry of Science (MINCYT) that was quickly adapted to address pandemic-imposed challenges. MINCYT offered strategic direction to the initiative, by communicating pandemic-imposed government priorities to steer the programme's focus on proposals. The initiative received 1 056 applications and granted funding to 75 projects (de Silva et al., 2022[1]).

Governments can also build inclusivity goals into STI policy interventions. For example, Ireland's Competitive Start Fund for Female Entrepreneurs provides equity investment to women entrepreneurs to support the costs (including salaries, travel expenses and consultancy fees) associated with developing the business plan and reaching key technical and commercial milestones. Successful applicants receive an equity investment of up to EUR 50 000 (euros) from Enterprise Ireland, in return for a 10% share in the firm. A similar programme exists in Sweden, where the government created a state-owned venture capital company to support firms with growth potential in the country's northern regions that experience difficulties in accessing finance. In both these cases, policy makers have embedded clear inclusivity objectives in their STI policy interventions (Paunov and Planes-Satorra, 2017[2]).

As discussed in this recommendation and in Section 2 below, one avenue to improve inclusion in STI is to ensure broader participation in the actual design of policy interventions, so that they tackle local problems. An example of the effectiveness of more participatory approaches to innovation is the BruSEeau project, which ran from 2017 to 2020 and involved a collaborative approach between different research centres, an NGO and designers, with the aim of devising a community- and user-driven innovative solution to a local problem (in this case, water management). One of the key motivations in this programme was how to elevate an issue discussed by a narrow range of experts, but endowed with broader social importance, to an issue of political significance – a question that is relevant to many of the challenges discussed in the context of the sustainability transition (Kreiling and Paunov, 2021[3]; Crespin, 2020[4]).

16.1. Overview on innovation and inclusivity linkages

Innovation and inclusive growth interlink in six important and reinforcing ways (Paunov, 2019[5]). The first is the role of innovation in "increasing the pie", i.e. its contribution to growth, as well as the trade-offs involved in this growth. The second is the role of innovation in addressing societal challenges, such as ageing or climate change. The third is increasing societal engagement in innovation and getting more actors to participate in innovative activities. The fourth is the question of innovation disparities, i.e. the territorial, industrial, social and indeed, international divergences in innovation inclusivity and benefits. The fifth is the question of digital innovation, and the ways that the particular types of innovation prevalent in the digital economy can aggravate or mitigate inclusivity challenges. Finally, there is the question of participatory innovation and participatory STI policy making, which are discussed below. Greater participation in the design and implementation of STI policy can help identify unintended negative social consequences of policy interventions, and raise social buy-in for decisions taken by national and subnational governments. Box 16.1 presents the ways in which these linkages interact with territorial, industrial and social inclusion.

An additional, related question is that of STI inclusion and the success of technology and science diffusion. The development of vaccines during the COVID-19 pandemic exemplifies the intersection of inclusivity and uptake of science and technology: despite broad success, governments struggled to implement vaccine programmes owing to low societal trust. People who lived in countries with generally high aggregate levels of social trust in science were more likely to feel confident about being vaccinated, regardless of their individual level of trust in science (Sturgis, Brunton-Smith and Jackson, 2021[6]). The experience with COVID-19 vaccinations is an important lesson for the transitional context: if policy makers want the innovations and scientific knowledge necessary to the digital and sustainability transitions to diffuse across the economy, then it is imperative that society trusts the STI community. Inclusive and participatory approaches to policy making can play an important role in this regard.

Similarly, in light of the role played by the STI system in tackling the COVID-19 pandemic, societal attitudes towards – and expectations of – the STI system are changing. This presents both an opportunity and a challenge. On the one hand, greater societal support for the STI system in tackling "non-traditional' issues such as competitiveness can drive more public support and intervention for innovation. On the other hand, higher expectations of what the STI system can deliver (and when it can do so) can lead to disappointment.

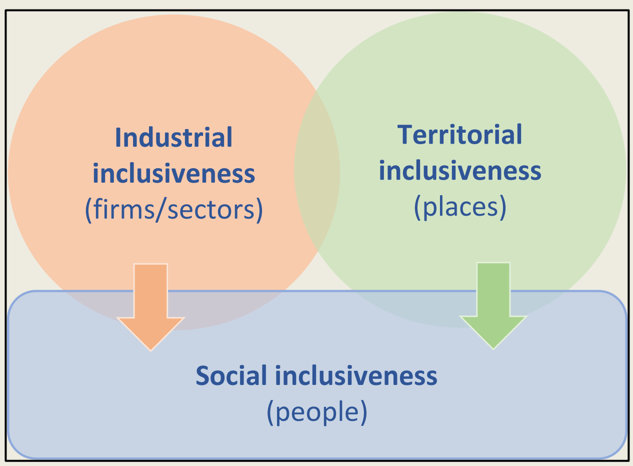
Greater participation and inclusion in the deliberation, design and implementation of STI policy is key to addressing these challenges.

Greater inclusion in innovation also has a higher instrumental value for policy makers, as it can support the *type* of innovation required for the digital and sustainability transitions. For example, given the importance of multidisciplinary approaches and facilitating new forms of knowledge transfer, the onus is on policy makers to support approaches to innovation that bring a wider range of participants to the table. As discussed in Chapter 11, innovative success in the sustainability transition is likely to require greater collaboration between disciplines, as well as new voices from outside the traditional confines of the STI system.

Box 16.1 Innovation and inclusivity

The features of a country's productive system play an important role in shaping inclusive growth. The concentration of innovation activities in certain industries and regions therefore has a complex but important relationship with inclusion and well-being. The sectoral and regional aspects of inclusion in innovation are referred to as "territorial inclusion" and "industrial inclusion"; both are closely linked to social inclusiveness.

Figure 16.1. Innovation and inclusivity



When innovation capacities are not widely distributed across sectors and regions, the well-being of individuals working in less innovative sectors or living in less innovative regions can suffer, inequalities can harden, and it may become more difficult to move into economic activities or regions with potentially higher participation in innovation.

Source: OECD (2017[7]), *Making Innovation Benefit All: Policies for Inclusive Growth*, https://www.oecd.org/innovation/inno/making-innovation-benefit-all.pdf.

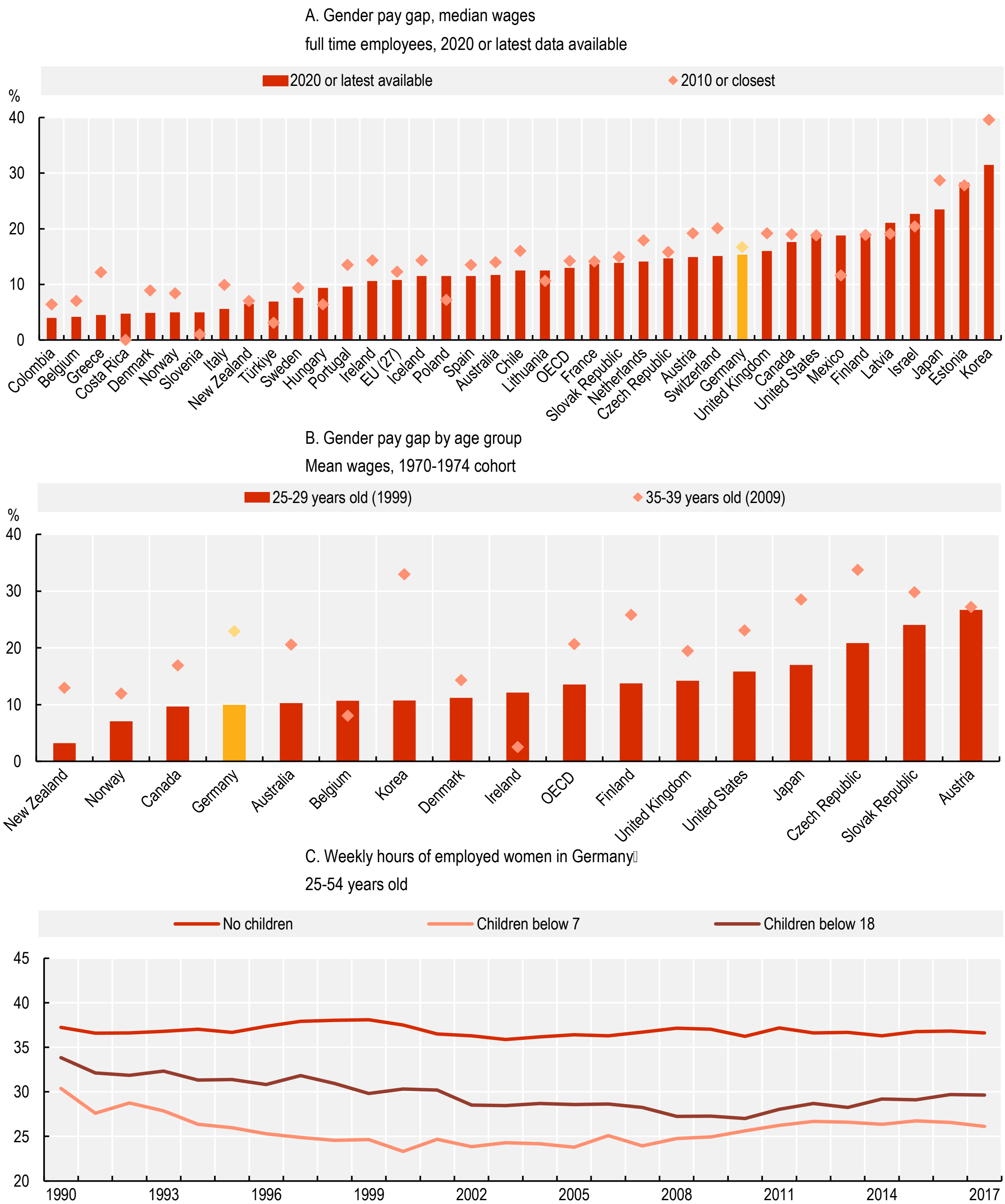
16.2. Participation in innovation

16.2.1. Gender and other inclusion challenges in the STI system

The distributional effects of the digital and sustainability transitions occur in the context of pre-existing inclusion challenges in Germany's STI system. One of the most notable examples of these challenges is that despite its strengths, participation in and gains from Germany's innovation system are unequally distributed along gender lines. As noted in the Overall Assessment and Recommendations (OAR) of this review and in the 2020 OECD Economic Survey of Germany, promoting participation in innovation and innovative entrepreneurship among women is likely held back by the same factors that discourage women's full-time employment – notably the high tax burden on second earners, and insufficient supply of full-day childcare and full-day schooling (Yashiro and Lehmann, 2018[8]).

Policy efforts to improve the inclusion of women in STI must take into account the broader socio-economic inclusion challenges for women. For example, the unadjusted gender wage gap of 20% has remained relatively unchanged for ten years (Panel A, Figure 16.2). The distribution of this gap shows age-related differences, with the gap increasing as women reach an age where they are most likely to have children (Panel B, Figure 16.2). There are a number of reasons for this persistent gap, including the high share of women engaged in part-time work and sectoral segregation (which explains about 30% of the wage gap) due to women being overrepresented in jobs with lower pay (OECD, 2020[9]). The high share of women in part-time employment is also linked to childcare, with the incidence of female part-time employment increasing significantly among women who have children under 7 years old. This likely has an impact on the careers of many women in sectors where they already face structural challenges (Panel C Figure 16.2), as detailed in the following sections.

Figure 16.2. Gender inclusion challenges in the German economy



Note: "Panel A: The gender wage gap is defined as the difference between male and female wages divided by the male wages. Full-time employees are defined as those individuals with usual weekly working hours equal to or greater than 30 hours per week. Panel B. Data for 25-29 years old refers to 1998 (instead of 1999) for Denmark, Korea, Norway and the Slovak Republic; to 1997 for Ireland. Data for 35-39 years old refers to 2008 (instead of 2009) for Australia, Austria, Denmark, Finland, Germany, Norway, Korea, and the Slovak Republic; to 2007 for Belgium, the Czech Republic and Ireland. For Austria, 25-29 refers to 20-29, 35-39 refers to 30-39.

Source: OECD (2022[10]), Gender wage gap (indicator). https://doi:org/10.1787/7cee77aa-en (Accessed on 06 April 2022) ,OECD (2012[11]), Closing the Gender Gap: Act Now, OECD Publishing, Paris, https://doi.org/10.1787/9789264179370-en, OECD (2020[12]), OECD Economic Surveys: Germany 2020, OECD Publishing, Paris, https://doi.org/10.1787/91973c69-en based on OECD calculations based on GSOEP v34.

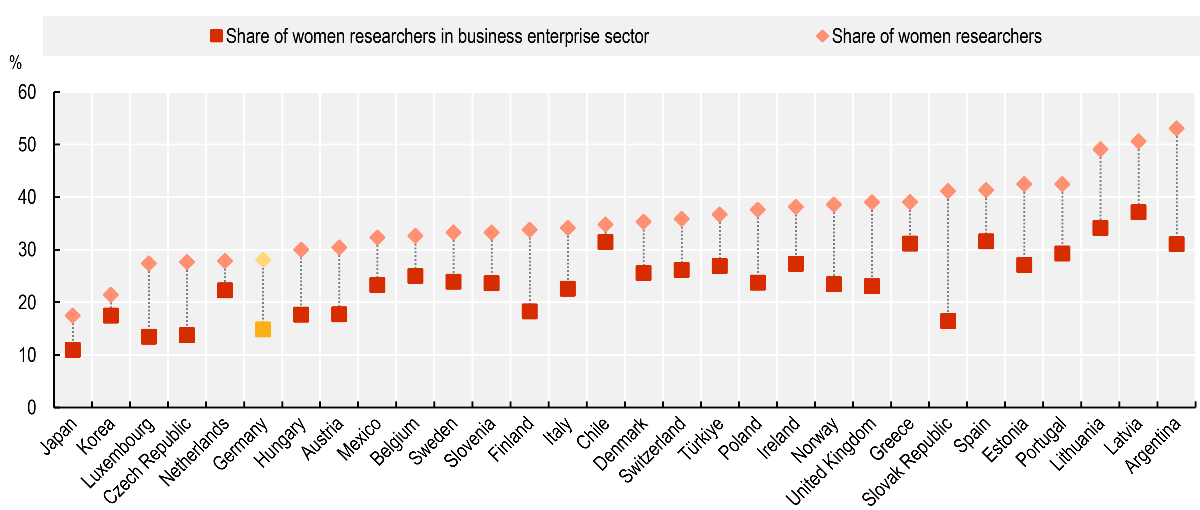
The under-representation of women in innovative activities also stems in part from the large share of business expenditure on research and development undertaken in fields of industry where the inclusion of women has historically been low, partly owing to the gender gap in STEM studies. Two out of three STEM tertiary graduates in 2018 were men, perpetuating the under-representation of women in key sectors. It is necessary to improve women's inclusion in STEM and the skills competencies of future innovators as innovation becomes increasingly digital and data-driven (OECD, 2020[9]).

Gender inclusivity gaps in the research base

The lack of female participation in the STI system starts with the orientation of the research base towards the STEM fields that support the country's leading innovative industries. The significant contribution of a handful of industries to German innovation and the traditionally male-dominated STEM domains underpinning these industries act structural barriers to women's participation and career advancement in innovation. In Germany, female STEM graduates numbered 11.8 individuals per 1 000 population in 2018, compared to 27.8 per 1 000 for male graduates (OECD, 2021[13]).

Given this under-representation of women in STEM, it is unsurprising that women are concomitantly under-represented in the leading innovative sectors. Notably, women account for 28% of total full-time employed researchers across the German research base, but only 15% in the business sector (Figure 16.3). Among the large industrial economies in the OECD, only Korea and Japan – two countries with a similar innovation focus on STEM areas – have lower levels of female representation than Germany.

Figure 16.3. Women are underrepresented in the German research community (2019 or latest year available)



Note: Headcount based, 2020 data for Japan, Korea, Mexico, Portugal, Slovak republic and Turkey
Source: OECD (2022[14]), "Main Science and Technology Indicators", OECD Science, Technology and R&D Statistics (database), https://doi.org/10.1787/data-00182-en (accessed on 06 April 2022).

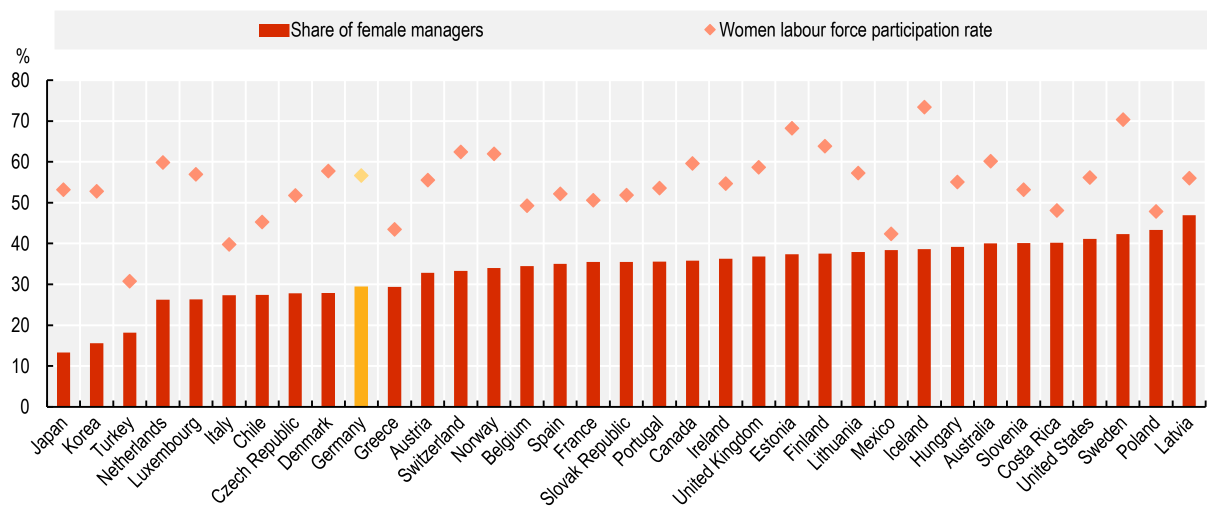
Output from the innovation system is indicative of the gender inclusivity challenge and the potential missed innovation contributions. For example, less than one in ten German Patent Cooperation Treaty (PCT) applications published in 2020 came from female inventors, likely reflecting that female inventors remain under-represented in some of Germany's key innovative sectors, such as transport (9.1% female PCT applicants globally in 2020), chemical engineering (15.1%) and electrical machinery (11.7%) (WIPO, 2021[15]).

Women in STI leadership

Women remain a minority in management positions in both established sectors and the start-up community. This could have an impact on the future competitiveness of the German economy, as well as on inclusivity. In 2018, only 29% of women worked in a managerial position, despite accounting for 46% of the labour force (Figure 16.4). The dearth of women in leadership positions is even more pronounced in start-ups: according to the latest OECD data, only 13% of technology start-ups in Germany were led by women in 2015 (OECD, 2020[9]).

Figure 16.4. Women are under-represented in managerial positions

Female share of management employment and female share of labour force, all ages, %, 2020 or latest available year

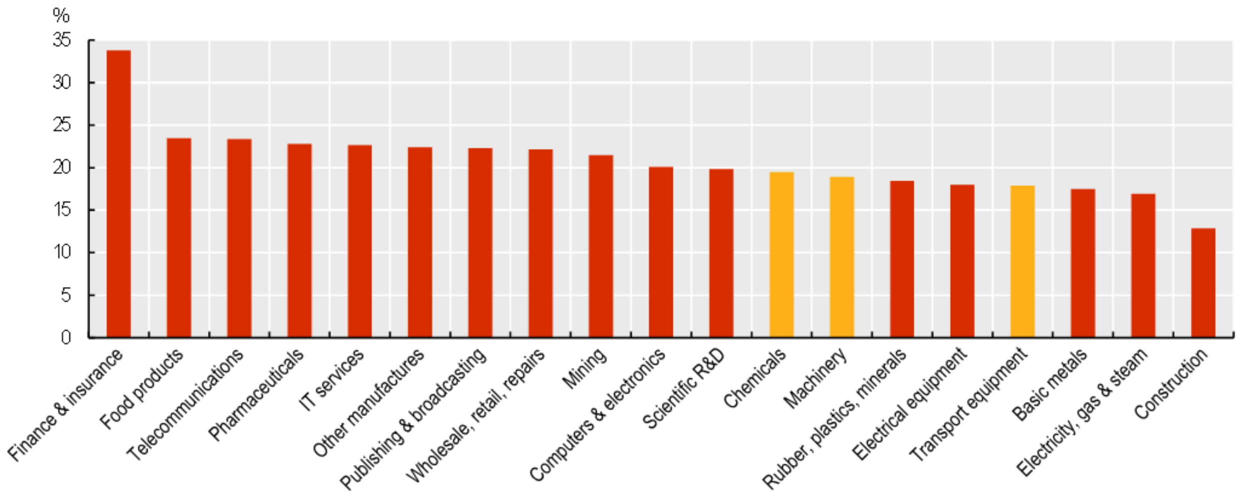


Note: Data corresponds to 2019 value for Germany and United Kingdom
Source: OECD (2022[16]) Gender employment database https://stats.oecd.org/Index.aspx?DataSetCode=GENDER_EMP based on ILO (2021), SDG indicator 5.5.2 - Female share of employment in managerial positions (%) - via https://ilostat.ilo.org/data (accessed on 1 June 2022)

The sectoral distribution of innovation activity in Germany also likely acts as a structural barrier to female leadership in the STI system. In chemicals, machinery and vehicle manufacturing– the rate of female leadership is particularly low. The average share of women on the board of directors of the world's top R&D investors in these sectors was 19.5% (chemicals), 18.9% (machinery) and 17.9% (vehicle manufacturing) (Figure 16.5). The low level of female participation at leadership levels in top R&D corporations in a range of sectors also demonstrates that the low levels in Germany are not necessarily a country-specific challenge, but rather an internationally structural challenge with domestic ramifications.

Figure 16.5 Gender leadership of the world's top R&D investors, by sector (2018)

Average share of women on the board of directors, ISIC Rev.4



Note: Data relate to sectors with at least 20 company headquarters in the top 2 000 corporate R&D sample.
Source: OECD/JRC (2021[17]), *World Corporate Top R&D Investors: Paving the way for climate neutrality*, http://dx.doi.org/10.2760/49552.

Beyond gender, barriers to participation in innovation, and their impact on social inclusion, exist along socio-economic lines. The inclusion of migrants plays an important role, not just in counteracting demographic pressures and associated labour shortages, but also in enhancing countries' innovation capacities and knowledge base. In Germany, migrants with a foreign qualification are at least three times more likely to be overqualified for their job compared to native peers, even when they have similar literacy skills – a higher gap than in other OECD countries (OECD, 2020[9])). With regard to entrepreneurial activities, individuals with a migration background make up 21.6% of all start-up founders surveyed in the recent German Start-up Monitor – about 3 percentage points less than the share of individuals with a migration background in the entire population (Kollmann et al., 2021[18])). This issue of lost innovation potential due to socio-economic inequalities, such as low social mobility (Chetty et al., 2018[19]), significantly below OECD average in Germany (OECD, 2018[20]), has been referred to as the "Lost Einsteins", namely that most successful scientists, entrepreneurs and innovators come from higher-income groups where they are more exposed to opportunities than in disadvantaged groups (Bell et al., 2018[21]).

Limited access to entrepreneurial and innovation activities is also an issue for youth. Germany features among the European countries where those aged 20-29 report the lowest levels of knowledge and skills necessary for starting a business relative to the entire adult population (OECD/European Commission, 2020[22])). Also, the share of youth who are business owners with employees (around 3%) is at the bottom end in European comparison and does not exceed the low overall level of business dynamism in Germany (OECD/European Commission, 2020[22])). Exclusion from innovation activities is often due to limited access to high-quality education (especially in important fields such as STEM), an issue that has been aggravated by the COVID-19 pandemic and the associated school closures (OECD, 2020[23]).

16.2.2. Participation in innovation: Open science and innovation in Germany

One important avenue for improving both the inclusion of society in innovation and the effectiveness of policy making in supporting innovation are open science and innovation programmes. To a certain extent, this relates to the participatory decision-making outlined in Section 2.4, although the focus here is on similar approaches applied to the innovation process itself. Examples of inclusive innovation processes involving civil society, such as BrussEAU, are provided in (Kreiling and Paunov, 2021[3]) and discussed above.

Open science can be an important means to support this collaboration, and in so doing, address some of the territorial and industrial barriers to participation in innovation hindering social inclusion. For example, open science and open innovation approaches can help SMEs participate in innovation activities with firms and research actors at the frontier, something that might not be possible through traditional knowledge and technology transfer avenues. A similar dynamic is true at the sectoral level, where sectors not traditionally involved in innovation activities can collaborate with innovative sectors, advancing the cross-sectoral diffusion of knowledge and technology.

16.3. Public attitudes towards STI

The COVID-19 pandemic led to an unprecedented level of public attention, scrutiny and hope vested in the STI system. In many ways, the global health crisis provided a glimpse of the expectations that may be placed upon STI in the years ahead, where innovation will play an ever-greater role in addressing challenges – such as demographic pressures caused by ageing societies, decarbonising industries and managing the consequences of climate change – impacting the daily lives of citizens and businesses. Ensuring that STI policy and innovation has the support of society is therefore key to the social and political sustainability of the directions that countries will take to meet these complex and transitional challenges. This is particularly true within the context of the sustainability and digital transitions, which are likely to have uneven distributional effects on society. If, for example, policy makers wish to decarbonise their economies, then bringing those who will be affected by this process to the decision-making table to discuss the consequences and opportunities will be critical to ensuring social acceptance of these decisions.

Encouragingly, Germany has a strong public majority in favour of government investment in scientific research and innovation, with some 77% of Germans answering a 2020 survey by Pew Research Center considering such investments a worthwhile use of public money (Pew Research Center, 2020[24]). Moreover, a clear majority (88%) consider it important that Germany is a world leader in scientific achievements (54% considered it very important, 34% somewhat important). These views correlate with those surveyed by the *Wissenschaft im Dialog*, the German organisation for scientific communication and social engagement, which found that 62% of respondents trust science and research, particularly by virtue of the expertise and integrity of scientists (Wissenschaft im Dialog, 2020[25]). It is notable that the figure was 52% before the COVID-19 pandemic, highlighting the potential role played by the health crisis in changing social attitudes towards the STI system. These social attitudes are important, since they legitimate – or repudiate – the approach taken by the federal and regional governments in supporting the international leadership role of the STI system.

Nevertheless, survey results indicate that attitudes towards “science” vary depending on the domain. For example, 43% of adults in Germany consider the use of robots and the development of AI to be bad for society, and 48% of adults considered the use of genetically modified foods to be unsafe (Pew Research Center, 2020[24]). It is here that the question of participatory decision-making and inclusive STI policy can help mitigate certain reservations. The point is not to say that reservations about certain innovations are without foundation, but to acknowledge that innovative progress will not always be automatically accepted by society. Bringing a greater variety of voices to the policy-making table can ensure not only that policy makers address reasonable reservations, but also take into account – and indeed learn from – social attitudes.

Social buy-in of STI will be important to the success of the sustainability transition, and policy makers must ensure that a broad swathe of society are pulling in the same direction. In the short and medium term, even if the changes that engender these costs render positive effects for well-being (e.g. lower greenhouse gas emissions and levels of particulate pollution, improved productivity through technology diffusion) at an aggregate level, some socio-economic groups will likely face costs. For example, the transition towards greener energy production will entail the closure of Germany’s remaining coal mines, while continued and advanced digitalisation and automation in manufacturing may also lead to further labour displacement. Ensuring that civic society has a say in how policies are made and implemented, and are involved in discussions on the costs and benefits of such decisions, is therefore vital if policy is to be seen as legitimate and durable.

16.4. Participation in STI policy processes

Supporting greater societal inclusion and participation in STI policy making offers a number of benefits. It would improve the quality of STI policy, by integrating the experience and knowledge of those affected by these processes in policy design and implementation. This also enhances social buy-in and legitimacy, as society is presented with decisions that have that have factored in stakeholders' expectations and concerns, rather than facing a technocratic *fait accompli*.

Germany already has several participatory processes for policy making. The challenge in the years ahead will be to expand these efforts and ensure that they support society through the twin transitions, all the while improving the effectiveness of the policies enacted to achieve them. The most notable example of German experience in participatory policy making is the *Bürgerrat* (citizens' assemblies) initiative. These assemblies convene randomly selected participants to discuss a variety of different policy domains, from democracy promotion to science, in a format similar to a focus group. The aim of these assemblies is to increase the diversity of the voices heard during the policy-making process. Once it has completed its deliberation, the assembly produces non-binding recommendations, which can be linked to direct democracy through referenda.

As part of the *Bürgerrat* process, a citizens' assembly was organised on the topic of research and science. The assembly' purpose was to issue recommendations on improving – rather than increasing – society's participation in science, creating opportunities for society to influence scientific processes, and defining the measures needed to promote social participation. The assembly met seven times between November 2021 and March 2022 – a period that saw increased societal interest in science owing to the COVID-19 pandemic and the role of the STI community in managing the crisis.

Germany also has experience with bottom-up and open approaches to participatory policy making. As part of the Innovation Strategy for the City of Hamburg, the local authorities set a particular focus on inclusion and consultation in its approach to STI policy making (City of Hamburg, 2021[26]). Over 300 representatives from industry, research and higher education, cultural organisations and civil society were brought in and consulted from the beginning of the strategy development process. This allowed a wide range of stakeholders to provide input, and jointly identify priorities, objectives and initiatives.

16.5. Territorial and industrial inclusion in STI

16.5.1. Regional inclusiveness

Innovation expenditure is concentrated in Germany's southern states, where leading industries (such as the automotive and machinery industries) tend to be located (Figure 16.6). Many of these *Länder* are also the country's most populous, meaning that they offer significant opportunities for the innovative output of these industries to benefit local socio-economic well-being. The challenge is largely an intra-regional one: it is less about bringing down the country's most leading regions than about bringing up those that are lagging, so that they can make a larger contribution to inclusive growth.

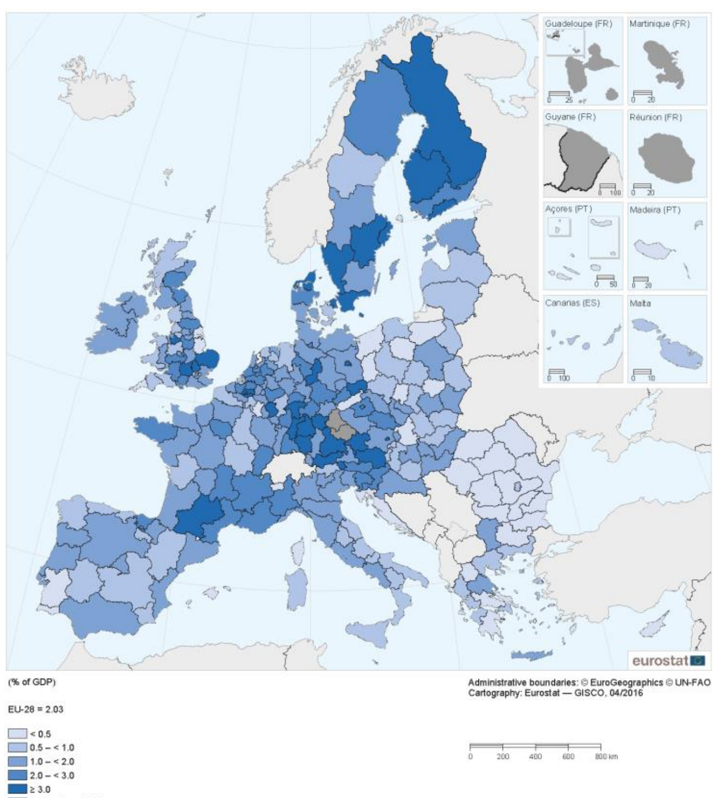
The uneven regional dispersion of R&I underscores the challenge of industrial path dependencies, their implication for the allocation of public research finance and the need to address regional divides. For example, the location of many of Germany's largest automotive manufacturers in top-performing states –

Munich (8.2% of European Patent Office patent applications), Stuttgart (8.2%), Frankfurt (4.2%), Düsseldorf (3.9%) – illustrates the extent to which the presence or absence of certain industries can determine a region's innovative success, and highlights the interconnectedness of innovation output and industrial location. In practical terms, the concentration of certain high productivity industries in a relatively small number of regions means that the gains are not evenly dispersed throughout the country.

The regional output of German innovation correlates strongly with the high geographical dispersion of the country's most innovative industries, which is nevertheless significantly lower than in other OECD countries. Germany does, however, have a lower geographical concentration in patenting among the top 10%, 5% and 1% of cities compared to key comparator economies such as Japan, the United States, the United Kingdom and France (Paunov et al., 2019[27]).

The gains and losses in the transformation of existing innovative industries, and the emergence of new ones, may correspond to existing regional inclusions divides and have implications on future territorial inclusiveness. Similarly, the issues discussed here relate to the uneven regional rollout of infrastructure investment necessary for an inclusive digital transition – which, if accelerated, could provide more opportunities for firms and entrepreneurs to become involved in innovation activities.

Figure 16.6. Gross expenditure on research and development (GERD) in Germany is concentrated in the southern states



Source: European Commission (2020[28])

The share of Germany's five most populous *Länder* (North Rhine-Westphalia, Bavaria, Baden-Wuerttemberg, Lower Saxony and Hessen) in GERD was 78% in 2017, largely linked to the location of the automotive sectors in these states and the network of SMEs that support them.

16.5.2. Industrial inclusion: The distributional effects of digitalisation and the green transition

The systemic diffusion of technologies such as AI and robotics will likely have significant consequences on labour displacement in existing industries, potentially making it harder for certain SMEs to participate in new areas unless they significantly upgrade their capacities. A 2021 study by the Federal Ministry of Labour and Social Affairs found that approximately 5.3 million jobs will disappear in the next 20 years (i.e. by 2040), while 3.6 million new jobs will be created (BMAS, 2021[29]). Although these findings integrate a range of issues other than just digitalisation, they are in line with OECD observations on the impact of technological transformations on the labour market. In addition to labour displacement through automation and digitalisation, Germany is likely to see labour-market challenges that will be compounded by the sustainability transition and an ageing population. A 2018 analysis of automation in OECD countries estimated that up to 18% of jobs in Germany are at high risk from automation, with another 36% at risk from significant disruption – one of the highest levels in the OECD (Nedelkoska and Quintini, 2018[30]).

The impact of digitalisation and the embedding of advanced technologies (such as robotics in manufacturing) will improve the efficiency of many private-sector firms but will cost jobs, although this may be offset by new jobs and higher productivity through the diffusion of these newer technologies (Aghion et al., 2020[31]). Labour markets are not perfect, however, and these labour-market imperfections may actually slow down the labour market's adjustment to automation, and weaken the diffusion of productivity gains and job creation. These challenges can be compounded by issues such as a lack of skills necessary to use these new technologies, the pace of digitalisation and automation, or (as argued by (Acemoglu and Restrepo, 2018[32])) the introduction of these technologies at the expense of other productivity-enhancing technologies (due, for example, to tax-code biases favouring investment in physical capital over human capital). The purpose here is not to argue against the diffusion of such technologies, but to note that their introduction can have socio-economic costs. STI policies should therefore be complemented by social and readjustment policies that support workers and firms during these transitions.

The "winner-takes-all" aspect of certain digital innovations can also compound social exclusion from technological progress. Furthermore, the skills necessary to succeed in the digital economy may disproportionately lock out certain groups and limit opportunities for firms of different sizes. Digital innovation in particular has several attributes that increase both inclusion opportunities and challenges. First, digital innovation is characterised by the "digital non-rivalry" rule governing one of its most important inputs – data. This means that data can be used by multiple users at any given time and can circulate at a very low marginal cost. In principle, therefore, location should no longer matter for innovation, as any person in any location should be able to participate (Guellec and Paunov, 2018[33]). The reality, however, is more complicated. The skills (e.g. coding) required to participate in digital innovation differ from those emphasised by the German education system. This means that the pool of people who are able to participate in digital innovation is smaller than it might be for other forms of industrial innovation. This dynamic is further complicated by the "winner-takes-all" aspect of digital innovation (due in part to the lower cost economies of scale and the resulting rentier economic models digital innovation can produce). The advantages derived from pooling data may reward large players, leaving little for smaller-sized firms. At the same time, the reduced scale of digital innovation activities may offer more opportunities. These combined factors therefore have significant consequences for social inclusion in digital innovation. As the transformation progresses, these effects should be assessed, and adjustments made to address critical inclusivity challenges. It also means that policy efforts aimed at building opportunities for *Mittelstand* firms and start-ups to participate in innovation processes create returns for social inclusiveness.

The sustainability transition will also have a profound impact on the current industrial composition of Germany's private sector, with related consequences for job creation and displacement. As noted in the 2020 OECD Economic Survey of Germany, although electric vehicles are simpler to manufacture than internal combustion engines (ICE) equivalents, many of the most valuable components (such as batteries and the semiconductors necessary for autonomous driving functions) are not yet manufactured in Germany. Achieving success in the sustainable transition – which would imply a larger uptake in electric vehicles – may therefore lead to a situation where fewer jobs are available in one of the country's most innovative industries (OECD, 2020[9]). A 2018 study by the Institute for Employment Research found that if 23% of new cars were electric by 2035 – the year the European Union will ban the sale of new petrol and diesel cars – then up to 114 000 jobs would be at risk and gross domestic product could decline by 0.6% (Mönnig et al., 2018[34]).

Owing to the geographically concentrated nature of mining regions, the push for industrial decarbonisation – and the related question of greening Germany's energy mix – will affect territorial inclusion. Just as the most innovative sectors in the German economy will be transformed by the sustainability transition, so too will the important network sectors – such as energy and transport – that support them. The sustainability transition will have a profound impact on these sectors, sometimes with asymmetrical socio-economic consequences. A notable example is the phasing out of coal in the German industrial mix. Germany's continued high levels of coal use for electricity production – the main reason the country has a higher per capita emissions output than other European OECD countries – is a major barrier to achieving the government's sustainability targets. Yet the mining of the lignite (brown coal) used in German coal-fired power generation is concentrated in some of the country's poorest regions, and the phasing out of coal production could harden existing territorial inclusion divides unless supported by social and labour-market policy interventions. A successful transition from the use of hydrocarbon energy sources to renewables, something which is a key policy goal of the government and a process in which the STI community must play an important role, will nevertheless involve a short-term social cost. Without appropriate social and economic policy interventions, this transition could engender long-term consequences for inclusion and wellbeing.

References

Acemoglu, D. and P. Restrepo (2018), *Artificial Intelligence, Automation and Work*, NBER Working Papers, No. No. 24196, NBER, https://www.nber.org/system/files/working_papers/w24196/w24196.pdf. [32]

Aghion, P. et al. (2020), *What Are the Labor and Product Market Effects of Automation? New Evidence from France*, Sciences Po Publications, https://ideas.repec.org/p/spo/wpmain/infohdl2441-170cd4sul89ddpnfuomvfm0jc0.html. [31]

Bell, A. et al. (2018), *Who becomes an inventor in America? The importance of exposure to innovation*, Centre for Economic Performance, London School of Economics and Political Science, https://cep.lse.ac.uk/pubs/download/dp1519.pdf. [21]

BMAS (2021), *Fachkräftemonitoring*, BMAS, Berlin, https://www.bmas.de/DE/Arbeit/Fachkraeftesicherung-und-Integration/Fachkraeftemonitoring/fachkraeftemonitoring.html. [29]

Chetty, R. et al. (2018), *The Opportunity Atlas: Mapping the Childhood Roots of Social Mobility*, National Bureau of Economic Research, Cambridge, MA, https://doi.org/10.3386/w25147. [19]

City of Hamburg (2021), *Regionale Innovationsstrategie der Freien und Hansestadt Hamburg*, City of Hamburg, https://www.hamburg.de/contentblob/4612440/dd3aaef3125b923ec4ca65743f411b6f/data/regionale-innovationsstrategie-hamburg.pdf. [26]

Crespin, D. (2020), *Case study from Belgium on BrusSEau - project on water management*, https://stip.oecd.org/stip/knowledge-transfer/case-studies. [4]

de Silva, M. et al. (2022), “Co-creation during COVID-19: 30 comparative international case studies”, *OECD Science, Technology and Industry Policy Papers*, No. 135, OECD Publishing, Paris, https://doi.org/10.1787/08f79edd-en. [1]

European Commission (2020), *The 2020 EU Industrial R&D Investment Scoreboard*, The EU Industrial R&D Investment Scoreboard, European Commission, Brussels, https://iri.jrc.ec.europa.eu/scoreboard/2020-eu-industrial-rd-investment-scoreboard. [28]

Guellec, D. and C. Paunov (2018), “Innovation policies in the digital age”, *OECD Science, Technology and Industry Policy Papers*, No. 59, OECD Publishing, Paris, https://doi.org/10.1787/eadd1094-en. [33]

Kollmann, T. et al. (2021), *Deutscher Startup Monitor 2021*, Bundesverband Deutsche Startups e. V., https://startupverband.de/fileadmin/startupverband/mediaarchiv/research/dsm/dsm_2021.pdf. [18]

Kreiling, L. and C. Paunov (2021), “Knowledge co-creation in the 21st century: A cross-country experience-based policy report”, *OECD Science, Technology and Industry Policy Papers*, No. 115, OECD Publishing, Paris, https://doi.org/10.1787/c067606f-en. [3]

Mönnig, A. et al. (2018), *Elektromobilität 2035: Effekte auf Wirtschaft und Erwerbstätigkeit durch die Elektrifizierung des Antriebsstrangs von Personenkraftwagen. (IAB-Forschungsbericht, 08/2018)*, https://doku.iab.de/forschungsbericht/2018/fb0818.pdf. [34]

Nedelkoska, L. and G. Quintini (2018), "Automation, Skills Use and Training", *OECD Social, Employment and Migration Working Papers*, No. 202, OECD, Paris, https://doi.org/10.1787/2e2f4eea-en. [30]

OECD (2022), *Gender employment database*, OECD, Paris, https://stats.oecd.org/Index.aspx?DataSetCode=GENDER_EMP. [16]

OECD (2022), *Gender wage gap* (indicator), https://doi.org/10.1787/7cee77aa-en (accessed on 19 August 2022). [10]

OECD (2022), "Main Science and Technology Indicators", *OECD Science, Technology and R&D Statistics* (database), https://doi.org/10.1787/data-00182-en (accessed on 19 August 2022). [14]

OECD (2021), *OECD Economic Outlook 2021*, OECD Economic Outlook, No. Volume 2021, Issue 1, OECD Paris, https://www.oecd-ilibrary.org/docserver/edfbca02-en.pdf?expires=1630507073&id=id&accname=ocid84004878&checksum=272B0DBD6DF2943C8423BD3C753E8ADF. [13]

OECD (2020), *OECD Economic Surveys: Germany 2020*, OECD Economic Surveys, OECD, Paris, https://www.oecd-ilibrary.org/economics/oecd-economic-surveys-germany_19990251. [9]

OECD (2020), *OECD Economic Surveys: Germany 2020*, OECD Publishing, Paris, https://doi.org/10.1787/91973c69-en. [12]

OECD (2020), "Youth and COVID-19: Response, recovery and resilience", *OECD Policy Responses to Coronavirus (COVID-19)*, OECD Publishing, Paris, https://doi.org/10.1787/c40e61c6-en. [23]

OECD (2018), *A Broken Social Elevator? How to Promote Social Mobility*, OECD Publishing, Paris, https://doi.org/10.1787/9789264301085-en. [20]

OECD (2017), *Making Innovation Benefit All: Policies for Inclusive Growth*, OECD, Paris, https://www.oecd.org/innovation/inno/making-innovation-benefit-all.pdf. [7]

OECD (2012), *Closing the Gender Gap: Act Now*, OECD Publishing, Paris, https://doi.org/10.1787/9789264179370-en. [11]

OECD/European Commission (2020), "Policy brief on recent developments in youth entrepreneurship", *OECD SME and Entrepreneurship Papers*, No. 19, OECD Publishing, Paris, https://doi.org/10.1787/5f5c9b4e-en. [22]

OECD/JRC (2021), *World Corporate Top R&D Investors: Paving the way for climate neutrality*, Publications Office of the European Union, https://doi.org/10.2760/49552. [17]

Paunov, C. (2019), *Inclusive Prosperity: Recoupling Growth, Equity & Social Integration*. [5]

Paunov, C. et al. (2019), *On the Concentration of Innovation in Top Cities in the Digital Age*, OECD Science, Technology and Industry Policy Papers, OECD, Parid, https://www.oecd-ilibrary.org/docserver/f184732a-en.pdf?expires=1637317457&id=id&accname=guest&checksum=B61793EABD810428C86B97D75019BDD8. [27]

Paunov, C. and S. Planes-Satorra (2017), *Inclusive Innovation Policies: Lessons from international case studies*, https://www.oecd-ilibrary.org/docserver/a09a3a5d-en.pdf?expires=1648046648&id=id&accname=ocid84004878&checksum=D6E72306BDD391C8ABFB6CB931399A09. [2]

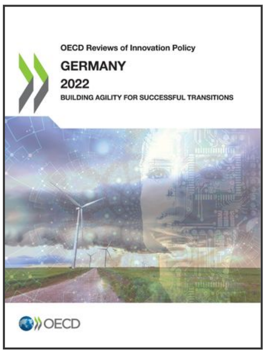
Pew Research Center (2020), *Public Views About Science in Germany*, PEW Research Center, https://www.pewresearch.org/science/fact-sheet/public-views-about-science-in-germany/. [24]

Sturgis, P., I. Brunton-Smith and J. Jackson (2021), *Trust in science, social consensus and vaccine confidence*, Nature Human Behaviour, No. 5, Nature, https://doi.org/10.1038/s41562-021-01115-7. [6]

WIPO (2021), *Patent Cooperation Treaty Yearly Review 2021: The International Patent System*, Patent Cooperation Treaty Yearly Review`, WIPO, Geneva, https://www.wipo.int/edocs/pubdocs/en/wipo_pub_901_2021.pdf. [15]

Wissenschaft im Dialog (2020), *science barometer 2020*, Wissenschaft im Dialog, https://www.wissenschaft-im-dialog.de/en/our-projects/science-barometer/science-barometer-2020/. [25]

Yashiro, N. and S. Lehmann (2018), "Boosting productivity and preparing for the future of work in Germany", *OECD Economics Department Working Papers*, No. 1502, OECD, Paris. [8]



From:

OECD Reviews of Innovation Policy: Germany 2022

Building Agility for Successful Transitions

Access the complete publication at:

https://doi.org/10.1787/50b32331-en

Please cite this chapter as:

OECD (2022), “More seats at the table: Participation and inclusivity in German innovation”, in *OECD Reviews of Innovation Policy: Germany 2022: Building Agility for Successful Transitions*, OECD Publishing, Paris.

DOI: https://doi.org/10.1787/962ecc07-en