

Fackler, Thomas; Falck, Oliver; Goldbeck, Moritz; Hans, Fabian; Hering, Annina T.

Article

The slow end of the ICE age in Germany\$insights from job postings on the automotive industry's trajectory

EconPol Forum

Provided in Cooperation with:

Ifo Institute – Leibniz Institute for Economic Research at the University of Munich

Suggested Citation: Fackler, Thomas; Falck, Oliver; Goldbeck, Moritz; Hans, Fabian; Hering, Annina T. (2024) : The slow end of the ICE age in Germany\$insights from job postings on the automotive industry's trajectory, EconPol Forum, ISSN 2752-1184, CESifo GmbH, Munich, Vol. 25, Iss. 6, pp. 49-56

This Version is available at:

<https://hdl.handle.net/10419/308557>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

Thomas A. Fackler, Oliver Falck, Moritz Goldbeck*, Fabian Hans and Annina T. Hering

The Slow End of the ICE Age in Germany: Insights from Job Postings on the Automotive Industry's Trajectory

As the German economy grapples with a downturn in the wake of the pandemic and compounded by years of geopolitical upheaval, the transition to e-mobility within the automotive industry, Germany's largest manufacturing industry, is facing increasing pushback.¹ The enthusiasm for electric vehicles (EVs), which surged after the "Dieselgate" scandal of 2015, has waned among politicians, industry, and the public alike. The fear of losing well-paying jobs tied to the internal combustion engine (ICE) – a technology where Germany remains a global leader – is pervasive. In September 2024, Germany's largest carmaker, Volkswagen, revoked job guarantees and is now openly considering domestic plant closures. There seems to be a growing clamor for delaying the "end of the ICE age" in order to benefit from the attractive margins of the legacy technology for a few more years, especially in view of the fierce competition in the EV market and the industry-wide weakness in consumer demand. This weakness is also evident in global markets, an unsettling situation given that three-quarters of cars produced in Germany are exported.²

The phase-out of the combustion engine is a central element of the EU's "Fit for 55" climate policy initiative of 2021, which includes legislation passed in spring 2023 mandating that only zero-emission vehicles be sold in the EU from 2035 onward. Additionally, the emission standards introduced in the 1990s and progressively tightened thereafter are to be updated, with the strict Euro 7 norm set to be enforced from 2025 onward. In 2021, the German government declared the ambitious goal of having 15 million EVs on the road by 2030. Recently, however, with the national election approaching in 2025, concerns about the economic impact of regulatory pressures are being voiced not only by opposition leaders such as Friedrich Merz

KEY MESSAGES

- **The debate on phasing out internal combustion engines (ICE) has resurfaced in Germany amid an economic downturn; whether this is smart appears questionable**
- **To monitor in real time where the industry is headed, analyzing job postings provides reliable insights into the ongoing strategic shifts in the automotive sector**
- **From mid-2019, postings of EV-focused firms have consistently exceeded those of ICE-focused firms, eventually being about twice as high by the end of 2023**
- **However, this gap in postings between EV- and ICE-focused firms has shrunk by 60 percent since December 2023, indicating a slowdown of the transition to e-mobility**
- **EV-focused firms scale back job ads for production-related roles disproportionately while ICE-focused firms decrease hiring to a greater extent for transformation-related occupations**

(see Footnote 1), but also by members of the governing coalition that has now broken apart over differences in economic policy. Just before the recent state elections, the Free Democratic Party (FDP), which held both the transport and finance ministries, released a transport policy roadmap explicitly condemning the ICE ban.³ At the EU level, President Ursula von der Leyen, re-elected this summer for a second five-year period, has promised to review the ICE ban in 2026. At a meeting with industry representatives in September, Robert Habeck, Germany's Minister of Economic Affairs and Climate Action, promised to lobby in Brussels for an earlier revision (and possibly relaxation) of the fleet carbon emissions targets, which the industry will likely fail to meet, facing multi-billion-euro fines. These political signals cast doubt on whether the existing regulation on the phase-out of ICE vehicles will stay in place, increasing uncertainty among both industry and consumers.

There is widespread agreement that a successful transition to e-mobility is essential in the medium term

* Corresponding author: goldbeck@ifv.de.

¹ See, e.g., Statement by Friedrich Merz, chairman and chancellor candidate of the German Christian Democratic Union (CDU), currently opposition leader, on X, August 21, 2024: "The combustion engine ban was a serious strategic mistake that the Federal Republic of Germany unfortunately agreed to. This was wrong and must now be corrected." (Translated from German: "Das Aus des Verbrennermotors war ein schwerer strategischer Fehler, dem die Bundesrepublik Deutschland leider zugestimmt hat. Das war falsch und muss jetzt korrigiert werden."), https://x.com/_FriedrichMerz/status/1826301024816005126.

² VDA Statistics for 2023, available at <https://www.vda.de/en/news/facts-and-figures/annual-figures/exports>.

³ Strategy paper titled "Roadmap Future – Policy for the Car" (in German: "Fahrplan Zukunft – Eine Politik für das Auto") from August 12, 2024, <https://www.fdp.de/fahrplan-zukunft-eine-politik-fuer-das-auto>.

to maintain competitiveness vis-à-vis the global automotive industry and, in particular, against all-electric manufacturers such as Tesla and BYD (Dechezleprêtre et al. 2023; IEA 2024; Wingender et al. 2024). Yet, the short-term economic impact of such a transition is the subject of intense debate, particularly with respect to job creation in the German labor market. EV production is not only less complex, but batteries, the key component, are largely sourced from abroad. Furthermore, Germany no longer seems to be the preferred production location for automotive firms, especially for the compact EV models required for the mass market. For example, Volkswagen announced it will produce its flagship electric compact car, the ID.2, in Spain, and Ford decided to close a production plant in the German state of Saarland in favor of a site in Spain.

Outside Europe, important markets for German car producers such as China and the US are becoming more and more competitive, especially as the share of EVs in automotive sales increases and all-electric producers claim a large portion of those markets. This is especially true for China, where German automakers have been producing more cars than in Germany since 2018 (Falck et al. 2023). With the shift toward EVs and ICE sales declining, German car producers are currently losing market share (Yang 2023; Global Trade Alert 2024). Considering all these factors, some argue that sticking to ICE vehicles would be beneficial for short-term labor market outcomes.

That is why the employment effects of the ongoing structural shift in the automotive industry are in the focus of policymakers. Demand for new hires is particularly well suited for the analysis of workforce dynamics, as firms' hiring patterns provide key insights into the type and amount of human capital that they require to implement their latest strategic priorities (Elfenbein and Sterling 2018; Ployhart and Kim 2014). As firms typically expand their knowledge base disproportionately through new hires, demand for new workers is especially valuable in tracking the latest trends in the labor market.

Firms' demand for new hires also offers insights into the trajectory of the automotive industry more broadly, since hiring is a highly reactive parameter of firms' decision-making. Hiring is how companies obtain the personnel needed for the coming years, if not decades, and is therefore inherently forward-looking (Gutiérrez 2020). Demand for new hires reflects firms' latest market assessments and strategic guidelines, which embody long-term expectations. As such, hiring demand is ahead of other indicators such as production when it comes to revealing structural shifts and is therefore well suited to understanding the current and likely future development of the industry.

Unfortunately, evidence-based insights into the green transition of the automotive industry are limited, as they require company-level data that distinguishes between companies that are driving the transition and those that continue to rely on traditional technologies. The survey data that is available tends to be at the industry level, not the company level, and relies on firms' stated plans and typically a small sample size. While there is work on measuring greenness at the occupational level by classifying the task content of jobs (Consoli et al. 2016), there is little empirical evidence at the firm level that assesses firms' decision-making with regard to technological specialization.

In this article, we build on our previous work (Fackler et al. 2024a and 2024b) to analyze recent labor market developments in the German automotive industry. To this end, we use data on online job advertisements (OJA) as a measure of hiring patterns, a major component of firms' labor demand. OJA trends provide valuable insights into workforce adjustments at the extensive margin in real time. By combining the near universe of OJA with patent data, we track hiring trends for firms with an EV focus versus those with an ICE focus. Our approach dynamically assesses demand for new hires from January 2018 through October 2024, capturing recent shifts in parallel to the evolving economic, political, and regulatory developments. Additionally, our data examines the structural



Thomas A. Fackler

is a Senior Lecturer in Digital Economy, Entrepreneurship and Innovation at the University of Surrey and a CESifo Research Affiliate. His research interests include innovation economics, digitalization, and labor mobility.



Oliver Falck

is the Director of the ifo Center for Industrial Organization and New Technologies, and Professor of Economics at the Ludwig Maximilian University of Munich. His research centers around innovation, digitalization, and regional economics.



Moritz Goldbeck

is an Associate at Analysis Group in San Francisco.* Previously, he completed his PhD at the University of Munich and was a Junior Economist at ifo Institute. His research interests include innovation, labor economics, and competition policy.

* The views expressed here are those of the author and do not necessarily reflect those of Analysis Group or its clients.

transformation in the occupational composition of active postings, focusing on differences between EV- and ICE-focused firms.

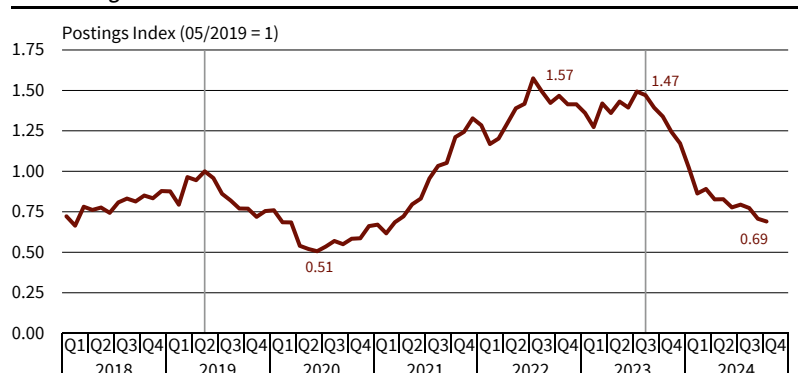
DATA

Our analysis is based on the combination of two data sources. First, we use patent data to determine which companies are more active in the field of green powertrain technologies. Second, we measure firms' demand for new workers using online job postings from Indeed, one of the world's largest online platforms for jobseekers.

We extract the patent portfolios of companies active in powertrain technology since 2000 from the *Patstat* database of the European Patent Office (EPO). To classify powertrain technologies, we rely on the established methodology of Aghion et al. (2016), which categorizes powertrain-related patents by their technology class based on expert interviews. *Green* technologies comprise mainly battery-electric vehicles (BEV), but also include plug-in hybrids (PHEV) as well as fuel-cell electric vehicles (FCEV). Conversely, we generally classify technologies related to internal combustion engine (ICE) vehicles technologies as *brown*.⁴ Based on their patent portfolios, we define companies as green (or *EV-focused*) if they have filed an above-median share of green patents. These are companies that have applied for more green patents relative to all classified propulsion technology patents (green and brown) than the median company. Companies with a below-median share of green patents are referred to as brown (or *ICE-focused*).

We combine this data with firms' demand for new hires, measured using online job ads from Indeed, through a name-matching procedure. The Indeed OJA data covers the near universe by indexing postings from company career websites and supplementing them with job postings directly published on the platform. Job postings are not only captured quantitatively at the company level, but also differentiated by harmonized occupational categories through text-based analysis. This allows us to study differences in the structure of active postings. We consider 2,383 companies for which both patent and job posting data are available. With this approach, we capture automakers and suppliers of all sizes, as well as other companies that are active in propulsion technology patenting. On average, green companies are smaller and less technologically specialized in the automotive and propulsion sectors than brown companies, measured by the size of their patent portfolios and the number of job postings. We track active postings on a

Figure 1
Job Postings of Automotive Firms



Source: Indeed; Patstat; authors' calculations.

© ifo Institute

monthly basis from January 2018 through October 2024, normalized to May 2019. During this period, our dataset gathers 1,598,894 unique published online job postings.

Building our analysis on OJA data implies that we regard demand for new hires as one of the main components of overall labor demand. We do not study other components of workforce adjustment, such as shifts due to reskilling or changing task content, layoffs, and (early) retirement. Note that although layoffs often dominate the public debate, they rarely occur and consequently represent only a small fraction of overall workforce adjustment. Further, looking at patent-active firms in Germany excludes firms that do not file patents or file patents only elsewhere. This implies that our focus is on firms innovating in Germany. Thus, our approach excludes postings of staffing agencies, which are usually not patent-active. Labor demand through staffing agencies is generally easier to adjust, making it more responsive; therefore, our estimates are likely conservative. Similarly, our data does not capture foreign companies conducting research and development outside Germany, which are mainly either firms with foreign headquarters or recent entrants.



Fabian Hans

is a Data Scientist at the Indeed Hiring Lab. His focus is on creating resilient data systems and scalable infrastructure to advance labor market research. With an emphasis on data quality and accessibility, he enables in-depth insights from complex datasets, enhancing research depth and accuracy.



Annina T. Hering

is a Senior Economist at Indeed Hiring Lab and holds a PhD from the University of Cologne. Her research focuses on the future of work, including labor market trends driven by technologies like AI, demographic change, and globalization.

⁴ Aghion et al. (2016) identify an additional category (grey) for combustion technology that primarily aims at improving efficiency. A more in-depth analysis of the development of individual green, grey, and brown technologies can be found in Falck et al. (2023).

WEAK HIRING IN THE GERMAN AUTOMOTIVE INDUSTRY

Figure 1 shows job postings of automotive firms in Germany over time as a postings index normalized to May 2019 (left vertical gray line). Generally, the overall volume of automotive postings follows the broader economic cycle. After a peak in job postings in mid-2019, there is a sharp decline through mid-2020, coinciding with the supply-side economic contraction during the pandemic. Starting in early 2021, job postings rebound, reaching a new peak by mid-2022. This high level persists for about a year. During this period, firms worked through the significant backlog in their order books built up during the pandemic and the subsequent supply chain disruptions. August 2023 marks the start of a pronounced contraction, indicated by the right vertical gray line in Figure 1. By October 2024, job postings decreased by 53 percent, in line with the economy-wide downturn in Germany and further exacerbated by industry-specific factors such as weak consumer demand for cars and a slowdown in leading export markets. As of October 2024, the overall level of job postings in the industry is still higher than the trough experienced during the pandemic but shows an unbroken downward trend.⁵

⁵ Note, however, that this comparison is conservative, as research indicates that the number of actual jobs behind online job ads has been declining over time – see <https://www.reveliolabs.com/news/macro/ghost-job-postings/>.

SLOWING TRANSITION TO E-MOBILITY

Figure 2 distinguishes postings of green and brown firms. The upper panel shows job postings relative to May 2019 (marked by the left vertical gray line), which is when the two groups begin to diverge. Note that the median split in greenness leads to similar overall job posting volumes prior to this divergence, since both groups also have a comparable size distribution.⁶ Since May 2019, the number of postings of green firms has been significantly and consistently higher than that of brown firms. During the pandemic, the number of postings for brown firms dropped by about 60 percent and remained low for nearly a year, while demand for new hires by green firms declined by only around 40 percent and began rising shortly thereafter. Importantly, postings of green firms recovered much faster, reaching an 84 percent increase in job postings compared to the May 2019 peak and sustaining that level until August 2023. In contrast, postings of brown firms only began to recover in late 2020, briefly surpassing their previous peak in early 2022.

Starting in August 2023, marked by the right vertical gray line in the upper panel of Figure 2, the number of postings of both green and brown firms dropped sharply by 54 percent for green and 52 percent for brown firms until October 2024. Currently, in October 2024, the number of job postings by green firms is about 10 percent lower than in May 2019, while postings of brown firms are about 51 percent lower. This suggests that green firms have been responsible for the bulk of demand for new hires in recent years, driving the industry's transformation toward e-mobility.

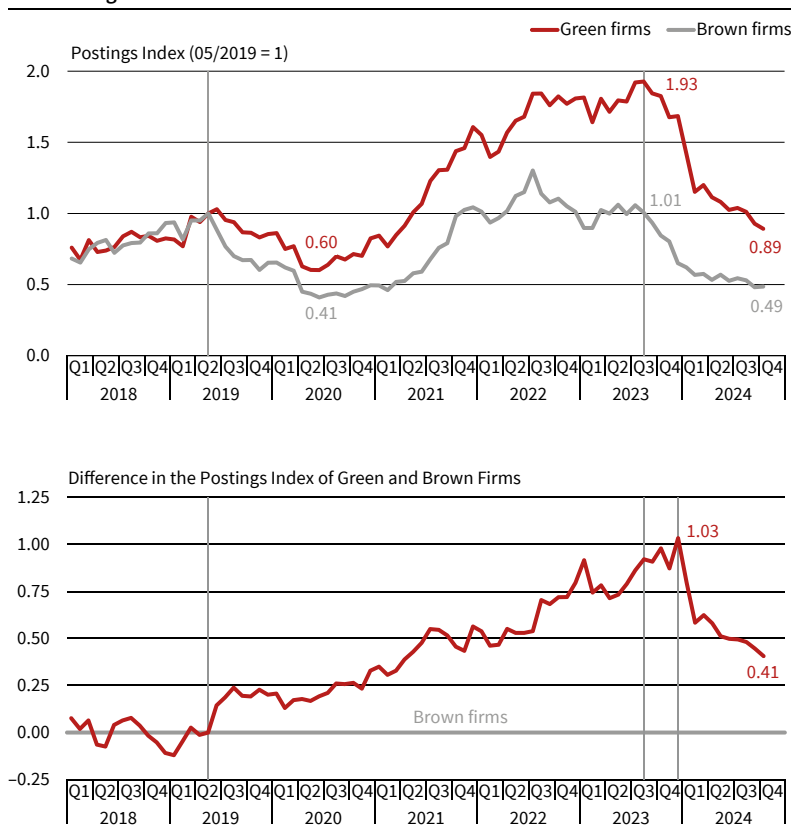
The lower panel of Figure 2 illustrates this development by showing the difference in normalized job postings between green and brown firms. The gap in postings between green and brown firms steadily widens from May 2019 until December 2023. Recall that in May 2019, overall job posting levels for both green and brown firms were comparable. By 2020, postings of green firms were already 20 percent higher than those of brown firms. This difference grew to about 50 percent by the summer of 2021 and remained at that level until July 2022. After that, the gap widened further, reaching its peak in December 2023, when demand for new hires of green firms was about double that of brown firms. This pronounced shift in the job postings volume toward green firms underscores the rapid transition toward e-mobility that the German automotive industry showed during this period.

Since December 2023, indicated by the right vertical gray line in the lower panel of Figure 2, with postings of green firms twice as high as those of brown firms, we observe a drastic reversal of this trend. The difference in job postings between green and brown firms has narrowed by 60 percent, dropping by 62 per-

⁶ In May 2019, job postings by green firms were at 101.94 percent of the level of brown firms.

Figure 2

Job Postings of Green and Brown Automotive Firms



Source: Indeed; Patstat; authors' calculations.

© ifo Institute

centage points. Currently, in October 2024, the number of job postings for green firms is only 41 percent higher than that of brown firms. This means that green firms still demand significantly more new workers compared to brown firms, but the pace of the transition has decelerated considerably. The narrowing gap between green and brown firms is in line with recent developments in the industry. Amid the general downturn and weak demand for electric vehicles, both firms and policymakers have scaled back their commitments to the transition to e-mobility.

HIRING SHIFTS TO DIFFERENT OCCUPATIONS FOR GREEN AND BROWN FIRMS

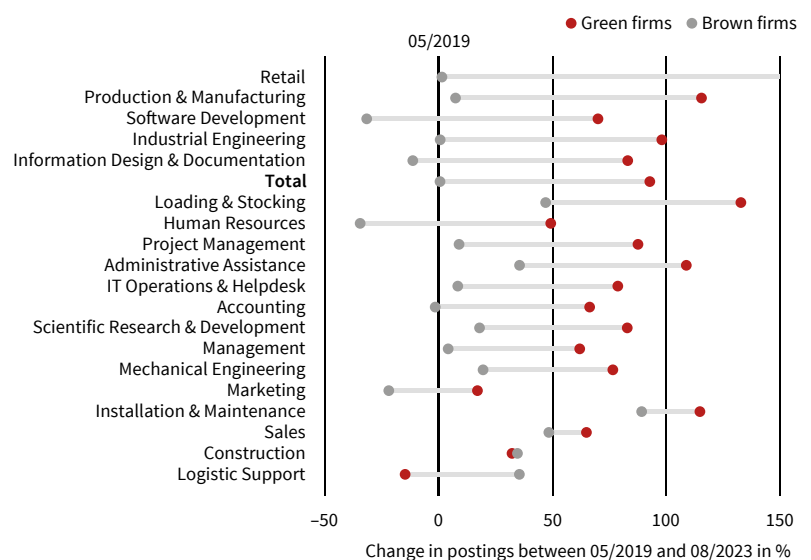
We further investigate shifts in the occupational composition of postings. To this end, we distinguish two phases. We call the period from May 2019, when postings of green and brown firms started to diverge, until August 2023, the start of the contraction, the *transformation phase*. Conversely, we call the period from August 2023 until October 2024 the *contraction phase*. Figures 3 and 4 highlight postings trends for the 19 largest occupational categories in the automotive industry during the transformation and contraction phases, respectively. Specifically, the graphs depict the change in the number of postings during each phase by occupation separately for green and brown firms. This means that, for each occupation, Figure 3 depicts the change in postings between May 2019 and August 2023 (the transformation phase). Dots on the zero line represent no change in postings during this period. Similarly, Figure 4 depicts the difference in postings between August 2023 and October 2024, with the zero line indicating no change during the contraction phase. Occupations are sorted by the difference between green and brown firms (depicted by gray bars), ranked by descending differences.

During the transformation phase, the number of overall postings of green firms almost doubled, while postings of brown firms are roughly at the level of May 2019 (see “Total” row in Figure 3). The number of postings of green firms grew in all occupations except logistics, which is consistent with fewer components needing to be sourced for EV production. The highest growth rate is observed for retail jobs, which capture occupations related to direct consumer sales. Importantly, there is a large expansion of demand for new hires by green firms in manufacturing-related jobs such as production workers, technicians, and warehousing. The above-average expansion of postings for administrative and engineering roles for green firms in parallel to production reflects firms’ expectation at the time to continue to expand production, triggering the need to adjust overhead and product development capacity.

The change in postings across occupations during the transformation phase is notably different for brown firms. Specifically, the decline in postings for

Figure 3

Change in Job Postings during the Transformation Phase, 05/2019–08/2023



Note: We cut off the value of green firm retail postings to improve the graph's readability.
Source: Indeed; Patstat; authors' calculations.

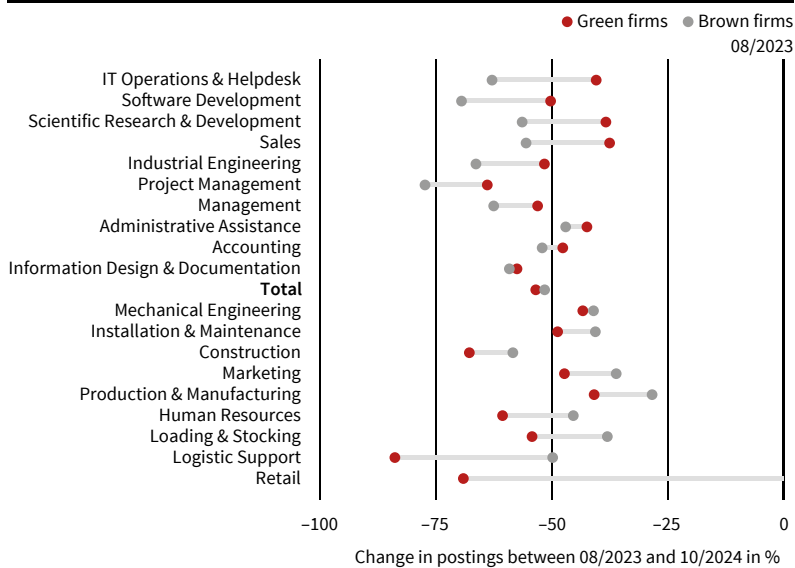
© ifo Institute

human-resources roles signals persistently lower overall labor demand by brown firms. Tellingly, postings of brown firms for software developers, a key occupation for the transformation, decline markedly. This development might be related to ICE-focused firms' increased outsourcing of the software stack to large tech companies and consultancies, as well as to decreased efforts in the area of autonomous driving. A higher number of brown firm postings is observed for technicians, logistics, and sales. This is linked to the still high demand for ICE vehicles during this time, the order backlog after the pandemic, and the need to manage international supply chain disruptions.

A pronounced difference in the shift of the occupational composition of postings between green and brown firms is also evident during the transformation phase, with retail roles showing the largest postings growth difference. This is in line with the minimal need for dealership networks in EV distribution compared to ICE vehicles, due to simpler maintenance and increased viability of over-the-air updates as well as more direct and online sales. In addition, there was stronger growth in the postings for production and manufacturing roles for green compared to brown firms, reflecting the shift of the overall production share toward EVs during this period. Note that green firms' postings for traditional production roles such as technicians (captured by the Installation and Maintenance occupational category) also grew faster than those of brown firms, but the difference is not as high. Further, the gap in posting growth is disproportionately large for software and information technology roles, with green firms increasing their search in these occupations much faster than brown firms. This suggests that automotive firms that are more engaged in the green transformation tend to drive the digital transformation of the industry as well.

Figure 4

Change in Job Postings during the Contraction Phase, 08/2023–10/2024



Note: We cut off the value of brown firm retail postings to improve the graph's readability.

Source: Indeed; Patstat; authors' calculations.

© ifo Institute

BROWN FIRMS SCALE BACK TRANSFORMATION-RELATED HIRING MORE AGGRESSIVELY

Figure 4 depicts the development of postings in the contraction phase after August 2023, when industry-wide hiring started to decline rapidly. The contraction is evident across all occupations and for both green and brown firms, except for an increase in the number of retail postings for brown firms, which is consistent with the renewed interest in ICE vehicles. While the average percentage decline until October 2024 is similar for green and brown firms (see "Total" row), there are considerable differences in the occupational composition. The strongest decline can be observed in the demand of green firms for roles in logistics and retail as well as technicians and construction, suggesting that activities related to the expansion of production are being scaled back. Likewise, postings for administrative roles and human resources also shrink disproportionately. This points to a permanent downward adjustment of green firms' expectations regarding consumer demand and, as a result, slower expansion of EV production.

The occupational structure of postings of brown firms changed in a significantly different manner during the recent contraction. The occupations showing the largest reductions are mostly related to the transformation and product portfolio development. For example, brown firms scale back hiring for roles in information technology and software development disproportionately, with research and development as well as engineering also experiencing below-average postings reductions. Similarly, postings for occupations in management decline strongly. This suggests a reorientation of ICE-focused firms toward existing products and business models.

Gray bars represent the differences in the contraction of postings by occupation between green and brown firms during the contraction phase. While demand for new hires by green and brown firms declines to a similar extent on average, there are significant differences across occupational categories. Green firms scale back to a lesser extent their postings for roles in information technology, software development, research and development, as well as engineering, all crucial for a continued transformation. The difference in the magnitude of posting contraction between both groups of firms emphasizes that brown firms re-oriented their workforce toward existing technologies and business models in the past year while green firms continued to prioritize transformation-related hiring. Likewise, green firms cut back demand for new hires less for sales and management roles, consistent with plans to counteract the consumer demand weakness and navigate the increased complexity of the transformation.

Conversely, postings of green firms decline more strongly during the contraction phase compared to brown firms in occupations related to production. This reflects the stronger decline in EV compared to ICE vehicle sales during the recent contraction and a readjustment of expectations about future consumer demand in the EV industry. Faster declines in postings for logistics and retail roles for green relative to brown firms underscore this development. Overall, the data during the recent labor demand contraction suggests that ICE-focused firms are prioritizing production and scaling back on transformation-related hiring. This is consistent with brown firms readjusting their expectations toward a continued slowdown or even a halt in the industries' transformation while green firms continue to prepare their workforce for sustained transformation, albeit at a much slower pace than in the previous years.

POLICY CONCLUSIONS

German carmakers and their suppliers have built up a commanding global lead in internal combustion technology, which has earned them an enviable reputation as premium manufacturers as well as industry-leading margins. But then the reality of global warming triggers the need for a green transition that includes phasing out ICE vehicles in favor of electric ones, upending a business model that has served the manufacturers splendidly so far and opening the market to new competitors. This presents both company leaders and policymakers with a conundrum: the decision of whether to stick with still highly profitable ICE vehicles for now, or to switch to electric ones that yield low margins today but are the market of the future.

Not surprisingly, automotive managers are reluctant to ditch their ICE vehicles just yet and policymakers are wary of the potential negative labor market ef-

fects of a quick shift to e-mobility. Although the transformation toward EVs accelerated after “Dieselgate,” it has lost momentum amid the current economic downturn. The resulting corporate and political signals reflect a weakened commitment to transitioning to e-mobility, compounding the effects of the recent dip in consumer interest in EVs. Are these concerns pointing in a future-suitable direction?

Our research suggests that, on the labor market, extending the ICE era is unlikely to foster new job creation. A resurgence of ICE technology is increasingly improbable, with all major global markets firmly committed to e-mobility. Our analysis shows that firms focused on EVs feature consistently higher demand for new workers, while ICE-focused firms are not catching up to EV-focused firms in terms of workforce adjustments related to green and digital jobs. Interestingly, this has remained true even during the recent slowdown, which hit EV manufacturers disproportionately hard, challenging the view that a decelerated transition provides ICE-focused firms with the time and resources needed to prepare their workforce for the EV era.

Our most recent data shows that ICE-focused firms are markedly decreasing postings in transformation-related roles, suggesting that they are restructuring their workforce back toward ICE production. This deceleration of the transformation since December 2023 is worrisome, given that the trend toward EVs had shown positive labor market outcomes in the past years.

In our opinion, regulatory and strategic uncertainty adds unnecessary barriers to the transformation, dampening both demand and the adoption of EV-related technologies. This creates a challenge for policymakers struggling to implement evidence-based regulation and industrial policy against the headwind of consumers currently leaning toward sticking to ICE vehicles, at least until they see clearer signals regarding e-mobility. Navigating these political pressures, particularly in pre-election periods, requires a reliable regulatory and policy path and, most critically, forward-looking communication about likely economic and societal outcomes.

Our job posting data shows that while domestic employment is a crucial societal goal, firms will necessarily aim to balance economic opportunity and available resources, including human capital. This calls for regulators and policymakers to recognize the discrepancy between public and private objectives and design policies accordingly. For the automotive industry in Germany, this requires upholding the regulatory phase-out of ICE vehicles to incentivize the continued shift toward EVs, thus ameliorating the risks of the industry cashing out on legacy technology while leading the workforce into a technological and economic dead end. An effective tool to accomplish this is to integrate the transportation sector into a reliable and sufficiently high intersectoral CO₂ pricing scheme in the medium term.

Additionally, supporting short-term policies are needed to guide the sector through a transition that entails abandoning highly profitable ICE vehicles in favor of low-margin EVs. This includes beefing up the electricity grids to accommodate the rollout of the required charging infrastructure and, crucially, cutting the red tape that slows down and increases the cost of the energy transition. It is undoubtedly a delicate balancing act, pitting societal needs for rapid infrastructure expansion against individual influence over local infrastructure construction, but the current speed of infrastructure build is too slow. Given the importance of the European market for the German automotive industry, especially in the premium segment, infrastructure is an important lever to benefit both domestic firms and consumers in a targeted way.

For labor market policymaking, regulators should keep in mind the implications of the significant shifts in the workforce’s occupational composition associated with the transition toward EVs, as our data shows. In general, information technology and software roles have become more important, while postings for traditional automotive occupations such as mechanical engineers and technicians are declining. EVs’ reduced product complexity also leads to a significantly lower number of postings for administrative and support roles. Labor market policy can help facilitate the transition by incentivizing labor mobility both in general and for brown-green job transitions in particular. The provision of evidence-based information about labor market prospects for different occupations would be an effective first step, while identification of skill gaps and supporting reskilling initiatives would further lead to improved workforce readiness. Fostering labor market efficiency by enabling worker migration both within and into the EU can help to alleviate skill shortages.

Generally, our data implies that policymakers should be careful not to slow down or even block structural change since shutting the door on such change seems neither economically beneficial nor effective. This is true when designing mitigation policies to soften individual negative or locally concentrated effects of the transition, but also when considering firm exit and entry. Specifically, the most economically sound policies will likely lead to brown firms shrinking or exiting the market and to the entry and growth of green firms. To further boost domestic employment, trying to attract foreign companies to establish production within the EU would be a good offsetting strategy, since from a global perspective, the natural tendency of the automotive industry is toward regional production. European economic policy should therefore embrace global competition: it is not only a catalyst for innovation and transformation of domestic firms, but also a chance to lure foreign carmakers to set up shop in the EU.

For firms, shifting to EVs is merely the ticket to participate in the future automotive market. The sec-

tor is undergoing a deep transformation, as reflected by the ongoing reshuffling in the described occupational composition of the automotive workforce and a fundamental redefinition of the product “car.” Yet, the industry is still in search of a viable new business model. This race being open is a huge opportunity for the European automotive industry and a major incentive for change, calling for a thorough rethink of old business models. Corporate innovation is therefore of paramount importance and should be incentivized, for instance through tax benefits for research and development. In addition to strengthening the labor supply in occupations related to the transition, innovation policies that promote disruptive innovation and entrepreneurship as well as greater labor market flexibility can help the automotive sector remain a competitive global player.

REFERENCES

- Aghion, P., A. Dechezleprêtre, D. Hemous, R. Martin and J. van Reenen (2016), “Carbon Taxes, Path Dependency, and Directed Technical Change: Evidence from the Auto Industry”, *Journal of Political Economy* 124, 1–51.
- Consoli, D., G. Marin, A. Marzucchi and F. Vona (2016), “Do Green Jobs Differ from Non-Green Jobs in Terms of Skills and Human Capital?”, *Research Policy* 45, 1046–1060.
- Dechezleprêtre, A., L. Milenko Fadic and G. Lalanne (2023), “How the Green and Digital Transitions Are Reshaping the Automotive Ecosystem”, *OECD Science, Technology and Industry Policy Papers* 144.
- Elfenbein, D. W. and A. D. Sterling (2018), “(When) Is Hiring Strategic? Human Capital Acquisition in the Age of Algorithms”, *Strategy Science* 3, 668–682.
- Fackler, T., O. Falck, M. Goldbeck, F. Hans and A. Hering (2024a), “Je grüner, desto höher: Die Arbeitsnachfrage von Unternehmen im Strukturwandel zur Elektromobilität”, *ifo Schnelldienst* 77(6), 30–35, <https://www.ifo.de/en/publications/2024/article-journal/arbeitsnachfrage-unternehmen-strukturwandel-elektromobilitaet>.
- Fackler, T., O. Falck, M. Goldbeck, F. Hans and A. Hering (2024b), “The Greener, the Higher: Labor Demand of Automotive Firms during the Green Transformation”, *CESifo Working Paper* 11160, <https://www.cesifo.org/en/publications/2024/working-paper/greener-higher-labor-demand-automotive-firms-during-green>.
- Falck, O., M. Goldbeck and T. Lixfeld (2023), *Die Grüne Transformation der deutschen Automobilindustrie: Eine Patentdatenanalyse*, ifo Studie, <https://www.ifo.de/DocDL/ifostudie-automobilindustrie.pdf>.
- Falck, O., L. Flach and C. Pfaffl (2023), “Spotlight Automobilbranche: Deindustrialisierungsschock oder absehbarer Strukturwandel?”, *ifo Schnelldienst* 76(3), 21–25.
- Global Trade Alert (2024), “Electric Shock: How China’s EV Boom Is Reshaping Global Markets”, *Zeitgeist Series Briefing* 18.
- Gutiérrez, E., B. Lourie, A. Nekrasov and T. Shevlin (2020), “Are Online Job Postings Informative to Investors?”, *Management Science* 66, 3133–3141.
- International Energy Agency (2024), *Global EV Outlook 2024*, <https://www.iea.org/reports/global-ev-outlook-2024>.
- Ployhart, R. E. and Y. Kim (2014), “Strategic Recruiting”, in D. M. Cable, Ed., *The Oxford Handbook of Recruitment*, Oxford University Press, Oxford, 5–20.
- Wingender, P., J. Yao, R. Zymek, B. Carton, D. Cerdeiro and A. Weber (2024), “Europe’s Shift to EVs Amid Intensifying Global Competition”, *IMF Working Paper* 24/2018.
- Yang, Z. (2023), “How Did China Come to Dominate the World of Electric Cars?”, *MIT Technology Review*, <https://www.technologyreview.com/2023/02/21/1068880/how-did-china-dominate-electric-cars-policy/>.