

## Green Skills in German Manufacturing

*Oliver Falck and Akash Kaura*

### Key Messages

- For all its perennial focus on traditional industries, Germany has done a remarkable job in greening its manufacturing
- Green skills are quickly gaining prominence
- Automotive manufacturing is leading the way
- Germany is still a hotbed of innovation, but cannot afford to become complacent



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EconPol POLICY BRIEF

A publication of the CESifo Research Network

Publisher and distributor: CESifo GmbH

Poschingerstr. 5, 81679 Munich, Germany

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# Green Skills in German Manufacturing

*Oliver Falck and Akash Kaura\**

August 30, 2023

Germany is an industrial powerhouse. In 2021, manufacturing accounted for 20.2% of its economy's gross value added, compared to 19.9% in Poland, 17.0% in Italy, 12.5% in Spain and 10.0% in France.

All the more disturbing then for company bosses and policymakers alike to see the oncoming waves of change sweeping across so many fronts simultaneously. Decarbonization, digitalization, electrification, policy changes, the waning prospects for the hallmark of Germany's automotive prowess—exquisitely engineered internal combustion engines—and growing competition from China, to name but a few. They all portend wrenching change.

In short, Germany's industry must adapt, and no better bellwether for how far along Germany is in this transition than its automotive industry.

The reason? It would be hard to overstate the importance of Germany's automotive industry for its economy. Directly or indirectly, it accounts for around 9% of GDP, employs more than 2.5 million people, and produces roughly 50% of the European value added in motor vehicle manufacturing. More than 50% of the value of intermediate products for German vehicle manufacturing is imported from EU-countries.

As in all sectors and industries, the foundation for effective change, far more than new processes or new products, is the acquisition and development of suitable skills among the workforce. And, in this case, the skills called for are of the green sort.

Unfortunately, the level of detail for a more reliable and thorough picture of the overall skills situation in the automotive industry is not available in the official administrative data. The next best way to find out how the skills landscape is greening up would be to

\* Oliver Falck: ifo Institute; Akash Kaura: LinkedIn. Tim Lixfeld provided excellent research assistance.

check what professionals (such as manufacturing engineers) say about themselves, and the foremost platform for that is LinkedIn.

And, indeed, the data made available by LinkedIn is sufficiently fine-grained to underpin every aspect of the analysis presented in this Policy Insight. The findings gleaned from the LinkedIn data are encouraging, albeit also indicative of the long road that still lies ahead.

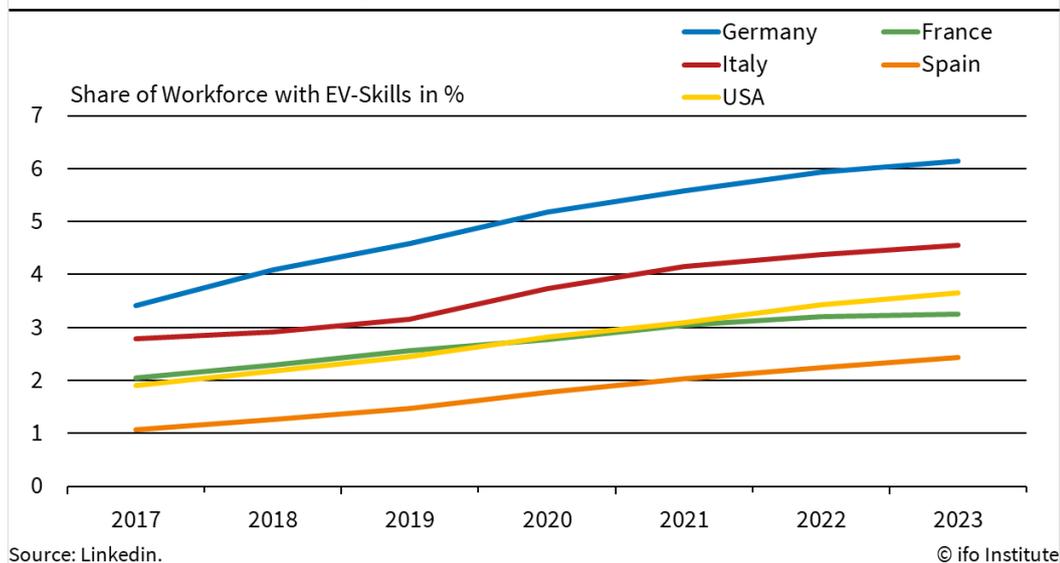
## Data-Based Insights

As it turns out, Germany’s internal combustion brigade can do electric. Not only that. Despite the country’s resistance to the EU’s plan of phasing out internal combustion engines within a decade or so, the Teutonic automotive machine is in fact propelling the nation’s green transition forward.

A comparison of the four largest European economies in terms of automotive value added, namely Germany (52.5%), France (9.2%), Spain (6.0%) and Italy (5.9%), plus the USA, shows that Germany’s electromobility skills are well ahead of all the other countries in the sample—and have been rising steadily for the better part of the past decade (Figure 1).

**Figure 1**

**Share EV-Skills in Car Industry**

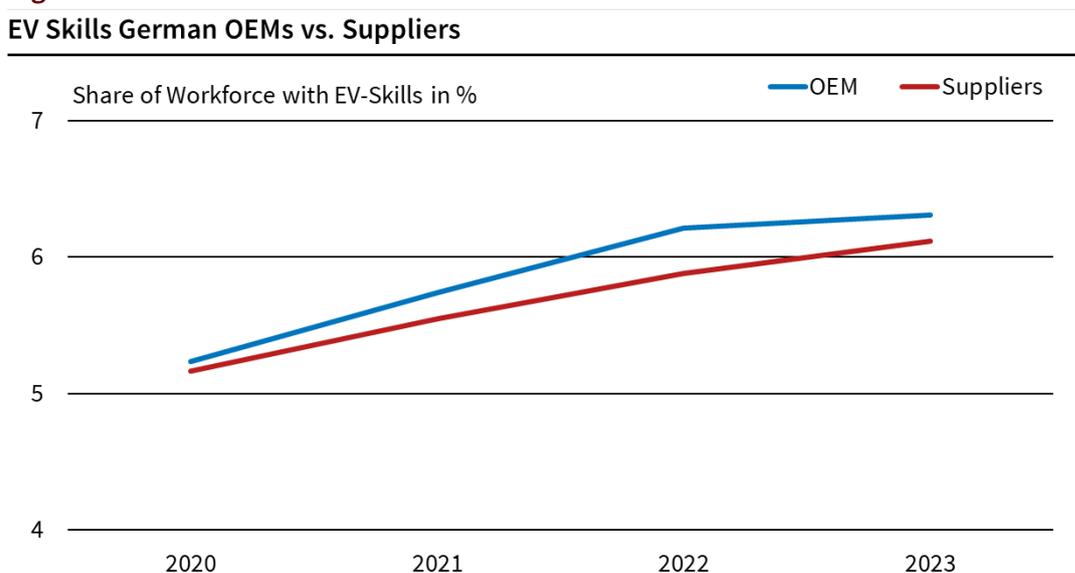


Comparing then the Big Four carmaking Original Equipment Manufacturers (OEM)—Audi, BMW, Mercedes and Volkswagen—with the US’s electric vehicle (EV) market leader shows that the German OEMs are actually around 1% ahead in terms of the share of workers possessing EV skills.

But it is not only the OEMs that are charging ahead: their suppliers too. In terms of EV skills, the data shows no big difference between the OEMs and their Tier-1 suppliers (Figure 2). This is not surprising: these Tier-1 companies are key suppliers to the entire EV manufacturing industry around the globe.

**Figure 2**

**EV Skills German OEMs vs. Suppliers**



Source: LinkedIn.

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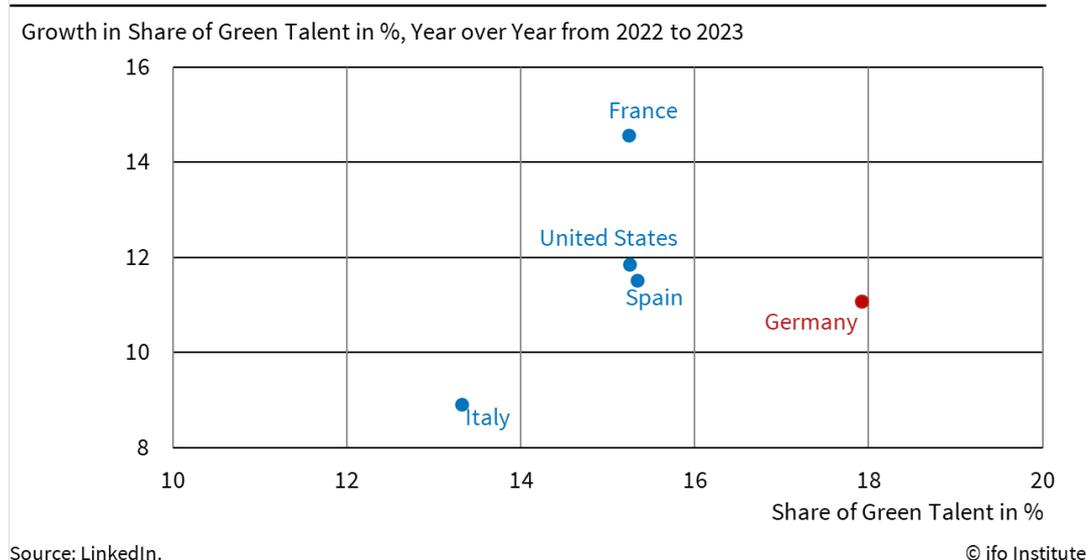
What are the skills in question? When discussing the EV skilled workforce in automotive, we refer specifically to green-tinged skills, i.e., those most closely associated with the electrification push: 'Electric Vehicles', 'Battery Charger', 'Battery Electric Vehicle (BEV)', 'Battery Management Systems', 'Battery Testing', 'Hybrid Electric Vehicles', 'Electric Cars', 'Electric Motors', 'Electric Power', 'Electric Propulsion', 'Electric Transmission', 'Electric Utility', 'Batteries', 'Lithium-ion Batteries', 'Lithium Batteries', 'Nickel', 'Cobalt', 'Lithium', 'Manganese', 'Graphite', 'Automotive Electrical Systems', 'Automotive Design', 'Automotive Engineering', 'Automotive Technology', 'Automotive Electronics', 'Fuel Cells', 'Powertrain', 'Energy Efficiency', 'Charging', 'Environmental Compliance', 'Environmental Policy', 'Energy Policy', 'Smart Grid', 'Electricity Markets', 'Power Systems', 'Power Transmission', 'Power Generation', 'Power Distribution'.

Carmakers hitherto steeped in internal combustion technologies cannot meet all their transition-related green skills needs simply through hiring, as Tesla does it in the US and elsewhere. While hiring has indeed been the German carmakers' main source of skills acquisition, to truly master the transition they will have to devote time and resources to equipping their long-serving workers with such skills through tailored training.

Looking at manufacturing in general in a European-plus-USA context, Germany still leads the way in the share of green talent, with 17.9%, ahead of Spain (15.3%), the United States (15.3%), France (15.2%), Italy (13.3%) and Poland (10.2%). However, the year-on-year growth in the share of green talent still leaves some room for improvement with France having the highest year-on-year growth (Figure 3).

**Figure 3**

**Growth vs. Share of Green Talent in Manufacturing (2023)**

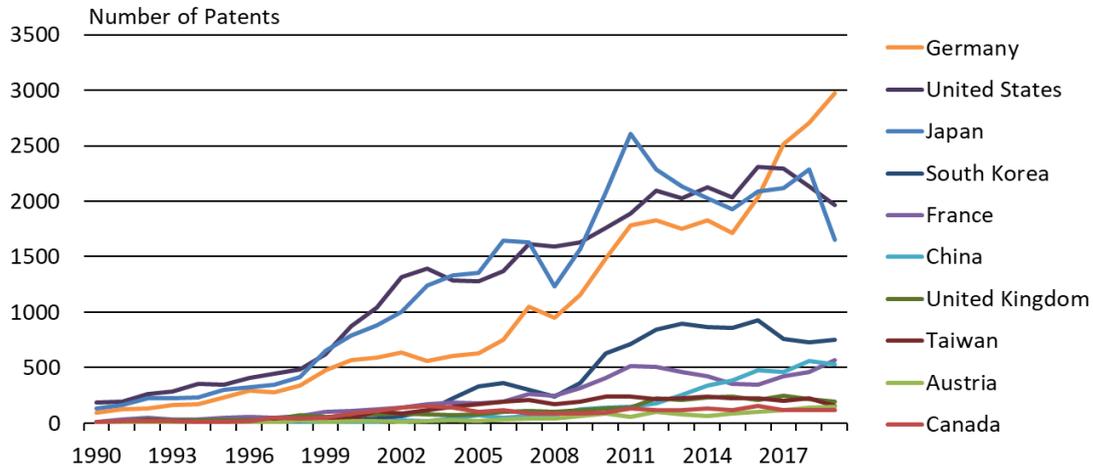


But this shows only the current state of green-skill affairs in Germany. To assess what the future direction is, a look at how quickly the country is innovating provides useful pointers, and the best way to assess this is to look at green patent filings.

Germany, again, scores remarkably well. Among the main innovators—USA, Japan, South Korea and a handful of others—Germany has caught up very quickly and now tops the ranking, with a clear upward trend that contrasts starkly with that of its two nearest competitors, the USA and Japan (Figure 4).

**Figure 4**

**Level of Green Patents in Automotive Industry by Country**



Source: OECD PatStat

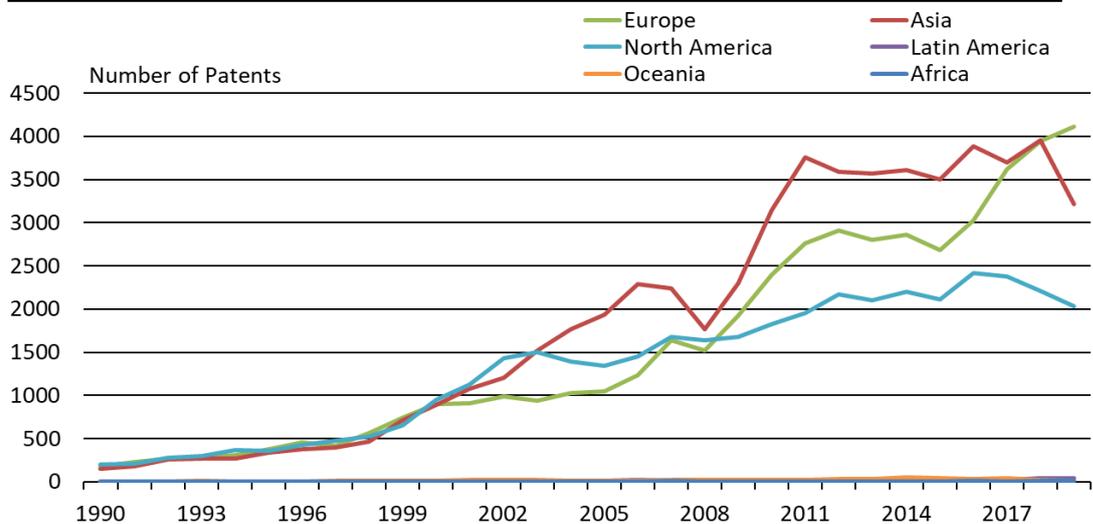
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Surprisingly, China does not appear to play much of a role in the innovation sweepstakes. That could be due to the fact that the patents and patent families examined for this briefing were filed with the US patent office and its European and Japanese counterparts, while Chinese firms either file patents only locally, or focus primarily on bringing existing technologies to market—or a mixture of both.

From a continent-to-continent perspective (Figure 5), Asia still has a tiny lead in terms of green patents, but it is on a downward trend, while Europe is on a strongly upwards one, boosted predominantly by Germany.

**Figure 5**

**Level of Green Patents in Automotive Industry by Continent**



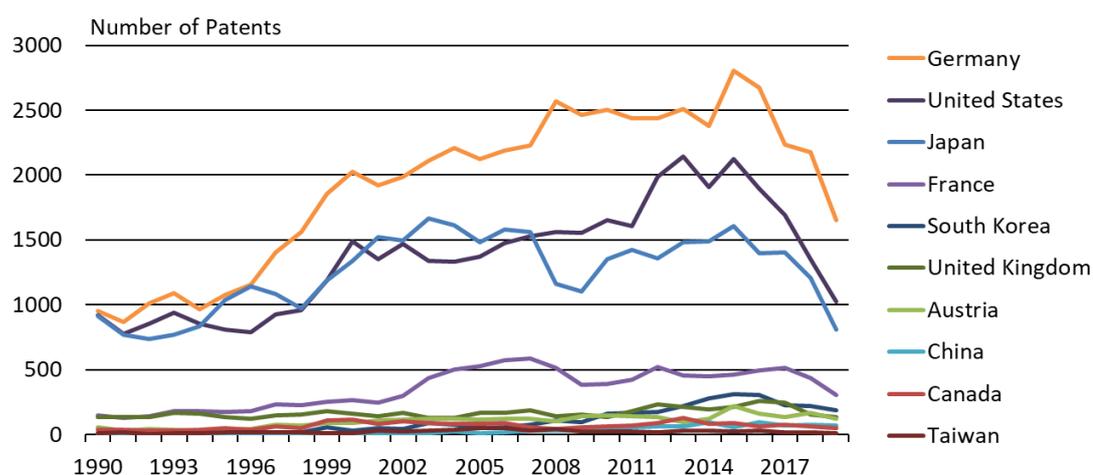
Source: OECD PatStat

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As to the technologies for which patents are being sought, it comes as no surprise that those related to internal combustion engines are fast becoming a rare breed (Figure 6a), while those related to electromobility have gained the upper hand (Figures 6b – 6d). But here the landscape is shifting fast too. Fuel-cell technologies (Figure 6b) were all the rage in the late 1990s and early 2000s, particularly in the USA and Japan.

**Figure 6a**

**Level Internal-Combustion-Engine Patents by Country**

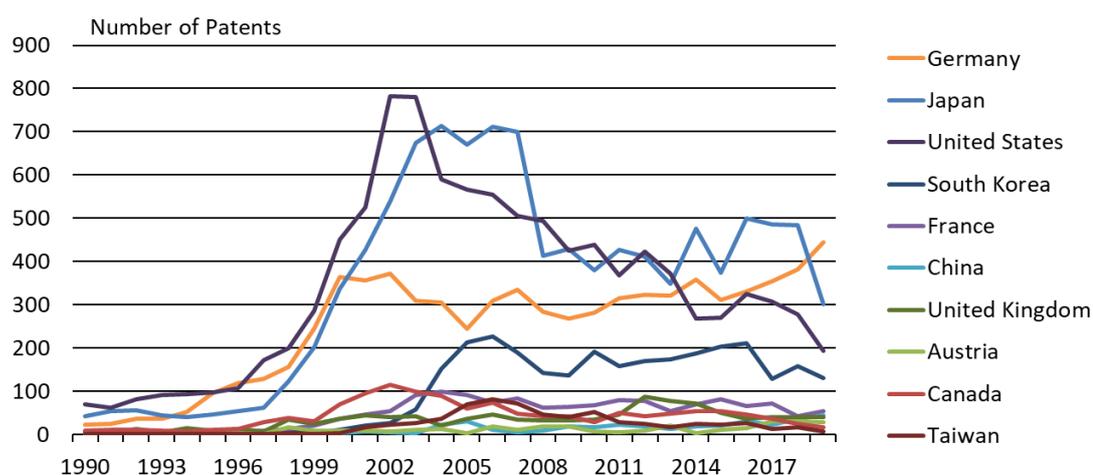


Source: OECD PatStat.

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**Figure 6b**

**Level Fuel-Cell-Electrical-Vehicle Patents by Country**

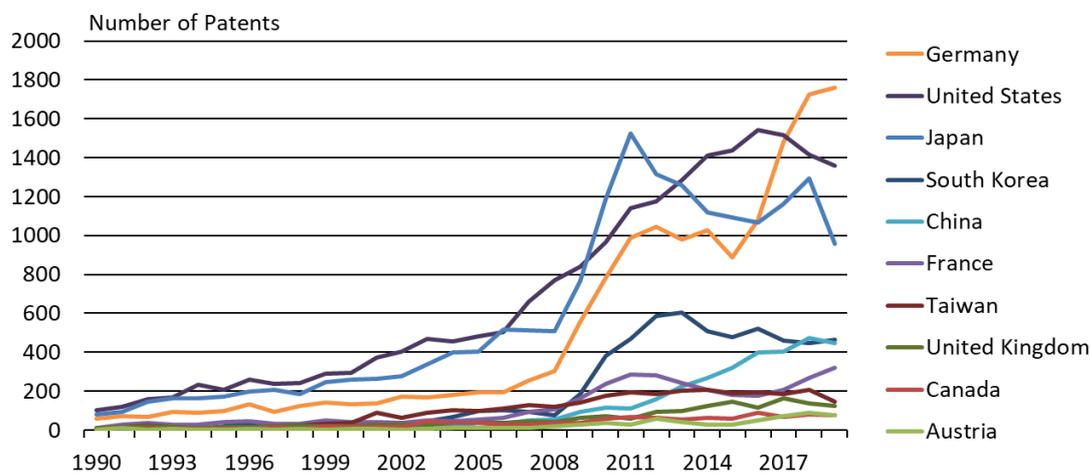


Source: OECD PatStat.

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**Figure 6c**

**Level Battery-Electrical-Vehicle Patents by Country**

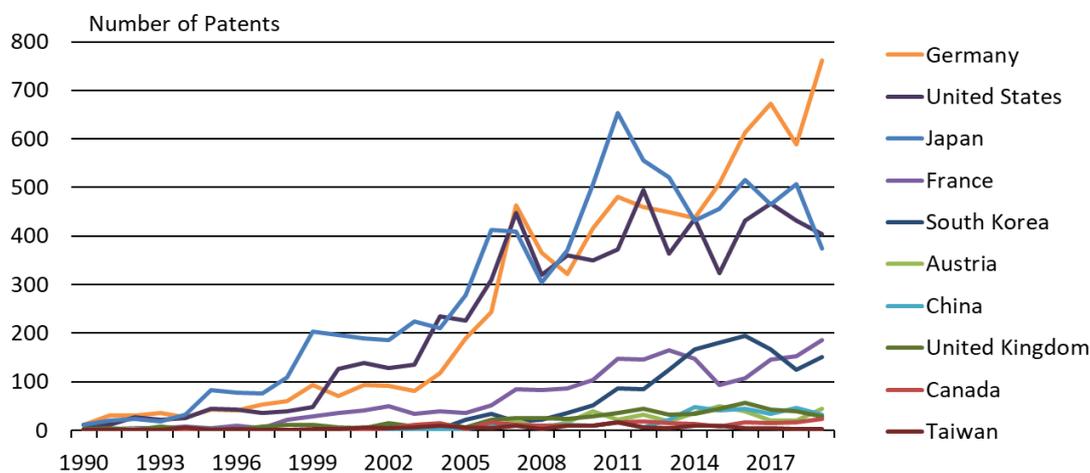


Source: OECD PatStat.

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**Figure 6d**

**Level Plug-in-Hybrid-Electrical-Vehicle Patents by Country**



Source: OECD PatStat.

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But Germany has not taken its eyes off the ball when it comes to battery-powered mobility systems (Figure 6c): it leads research in the field and it is still rising strongly, while Japan has declined from a very high peak in the early 2010s to the level of the USA, the third-ranked country—which incidentally has also been trending down. South Korea, while perking up, comes a very distant fourth.

Germany is also very active in plug-in hybrid research, with a commanding lead and a very strong upward trend (Figure 6d). The next two largest competitors, the USA and

Japan, in contrast, are on a clear downward course. Far lower in the scale, but trending up, are France and South Korea.

## Policy Implications

Although Germany, both through its automotive industry proxy and in manufacturing in general, scores surprisingly well in the green skills arena, it will need to up the game even more if it wants to ride the disruption wave instead of being swept aside by it.

The demand for green skills can only go up, drawing wages upwards in the process. Subsidies for the manufacturing of green automotive products, such as EVs and batteries, will further fuel wage increases—and will do nothing to ease the skills shortage.

Innovation, in turn, while still at respectable levels in Germany, cannot afford to become complacent: competitors from Asia to America are far from standing still.

Finally, the road to effective decarbonization goes unavoidably through electrification. And that, again, calls for the widespread availability of suitable green skills.

The challenge for policymakers is thus to devise policies that both spur and support innovation and skills-building without distorting competition. This calls for the right incentives to be put in place, such as state co-financing, either through tax rebates or direct subsidies, for reskilling and upskilling.

Innovation can be supported by lighter-touch regulations, for instance, and by more intragovernmental collaboration among different ministries and authorities. More concretely, innovation can be fostered through state-sponsored competitions to solve specific problems, such as decarbonizing a particular industry, with the winning company or entity reaping a duly attractive reward, financially and patent-wise.

But the most important government tool to spur innovation is putting a suitable price on carbon dioxide emissions. True, CO<sub>2</sub>-emissions pricing is already in force—albeit not as universally as it should—so what needs to be done now is to phase out the numerous exceptions and waivers still being doled out. This would make carbon-intensive products and processes increasingly unattractive across the whole spectrum, prompting the affected companies to look for affordable carbon-neutral alternatives. Crucially, it would leave it up to the companies themselves to select which technologies or approaches to adopt. And this, needless to say, will require a wide range of green skills to be available to them when and as they need them—which in turn calls for anticipatory government action to create the right framework for such skills to be imparted and to be acquired.

In short, imagination and creativity among policymakers, and willingness to revise procedures and regulations more critically, are essential to devise and implement forward-looking policies to simultaneously guide and support the transition towards green manufacturing and greener mobility—and to support the acquisition of green skills. Many of the mentioned policy options generate significant spillovers across borders within Europe and beyond. Thus, wisely revising procedures and regulations will also most likely touch the existing distribution of responsibilities between the EU and its member states.