Decarbonising energy intensive industries with focus on employment effects

Final narrative report

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Decarbonising energy intensive industries: what effects on jobs?

Final narrative

Energy intensive industries (EII) hold a central place in emissions reductions. The production of key materials and chemicals – steel, plastics, ammonia and cement – emits more than 530 million tonnes of CO2 per year (including electricity and end-of-life emissions) in the EU. Materials needs are still growing, and on a business as usual course, EU emissions from these sectors would be little lower in 2050 than they are today.

Emissions from these sectors have long been considered as 'hard to abate'. Carbon is inextricably linked into current production processes, either as a building block of the material (plastic), or in the process chemistry of their production (ammonia, cement, steel). Existing industrial low-carbon roadmaps have eschewed significant change, emphasising carbon capture as the key route to deep cuts – but still leaving some 30–40% of emissions in place in 2050. Industrial emissions are thus one of the main roadblocks to a net-zero economy. Previous studies have been extensively dealing with decarbonisation pathways mainly from a technological and industrial policy point of view, less focusing on employment and social effects. At the same time concerns among industry actors, trade unions and workers were growing about the uncertain future of nearly 3 million European jobs. Energy-intensive industries provide direct employment to around 2.6 million people and represent the foundations of critical and strategic value chains for the EU economy.

The aim of the project was to analysis and map decarbonisation pathways and estimate their employment effect, including also effects of a EU carbon border adjustment mechanism (CBAM). Case studies were performed for France, Germany, Italy, Poland, Spain and the UK with an econometric analysis for Germany and Poland, with a regional case study for the Taranto region in Italy and an EU27 analysis based also on an econometric modelling. Effects of a CBAM were modelled for Germany and the EU27, while national studies were also addressing the issue.

Key Research questions were:

- Mapping the landscape by main industry (steel, chemical, non-ferrous metals /cement/, for all countries and glass and paper for some).
- Description of employment trends in sector in the last decade.
- Examine GHG reduction trends, targets and policies.
- Key characteristics of the industries (technology, employment intensity, regional distribution).
- Main challenges and policies for the given industry (material).
- Mapping national industrial strategies in the selected member states
- Identify pathways for the decarbonisation of energy intensive industries (by country and material) and estimate employment effects depending on the decarbonisation pathways.
- Consider the possible effects of a CBAM, in terms of emissions reductions, employment for the sector and employment for the whole economy.
- Explore regional effects.

Assumptions for decarbonisation pathways were:

There are four possible pathways to reach net zero, reducing emissions by more than 500 Mt per year in 2050, but reflect different degrees of success in mobilising four different strategies for emissions reductions:

- *Increased materials efficiency* throughout major value chains (estimated emissions reduction of 58–171 Mt CO2 per year by 2050 for the EU). The opportunity for raising material efficiency is wide-ranging, including new manufacturing and construction techniques to reduce waste, new circular business models based on sharing and service provision. These solutions can reduce material needs from today's 800 kg per person per year to 550-600 kg, reducing emissions by as much as 171 Mt CO2 per year by 2050.

- *High-quality materials recirculation* (82–183 Mt CO2 per year by 2050). Large emissions reductions can also be achieved by reusing materials that have already been produced. Steel recycling is already integral to steel production, substantially reducing CO2 emissions. With plastics, mechanical recycling can grow significantly but also needs to be complemented by chemical recycling that requires lots of energy. By 2050, a 70% of steel and plastics could be produced through recycling, directly bypassing many CO2 emissions, as steel and plastics recycling can use green electricity and hydrogen inputs. In a highly circular pathway he total emissions reductions could be 183 Mt CO2 per year.

- *New production processes including the use of hydrogen technology* (143–241 Mt CO2 per year by 2050). Even with increasing material efficiency and reuse, the EU will still need some 180–320 Mt of new materials production per year. Current industrial processes are highly carbon intensive, but new processes now offer deep cuts to CO2 emissions. For steel, several EU companies are exploring production routes that switch from carbon to *hydrogen*. In cement, new cementitious materials like mechanically activated pozzolans or calcined clays offer low-CO2 alternatives to conventional clinker. For chemicals, several routes can be repurposed to use non-fossil feedstocks such as biomass or end-of-life plastics. Innovations are emerging to use electricity to produce high-temperature heat. In addition, large amounts of zero-emissions electricity will be needed, either directly or indirectly to produce hydrogen. In an ideal pathway, these new industrial processes could cut as much as 241 Mt CO2 emissions per year by 2050 by deploying.

- *Carbon capture and storage* / use (45–235 Mt CO2 per year by 2050). The main alternative to mobilising new processes is to fit carbon capture and storage or use (CCS/U) to current processes. This can make for less disruptive change: less reliance on processes and feedstocks not yet deployed at scale and continued use of more of current industrial capacity. It also reduces the need for electricity otherwise required for new processes. However, CCU is viable in a wider net-zero economy only in very particular circumstances, where emissions to the atmosphere are permanently avoided.

Key messages

EII-s have been shrinking in the last decade mostly due to world market effects, cost competition and overproduction in some market segments. Employment levels before the 2009 financial crisis could not have been restored and the Covid crisis has also had its toll. Steel industry employment in the EU28 has for example shrunk by 11 percent, from 365,000 in 2011 to 326,000 by 2020[1].

The good news for the industry reflected in both the econometric analysis and the country studies is that no further backlash on jobs is to be expected due to the upcoming deep decarbonisation process.

Decarbonisation will not be a job killer for the energy intensive industries, this is the main result of both econometric modelling and country case studies.

The actual effects will depend on several details, from financing and technology solutions to compensation mechanisms and active support, as discussed in the individual reports. While circular economy and material efficiency solutions offer genuine and deep decarbonisation, these also require substantial restructuring of production and labour processes with large scale transformative change (skills development and employment transitions), hydrogen technology and CCS are less disruptive. There latter

[1] https://www.statista.com/statistics/640374/steel-industry-employment-eu28/

have however huge investment needs and are not equally applicable by material and region, for CCS the abatement costs will be high, questioning its wide-scale viability.

Employment effects of technological path-ways will be different for the energy intensive industries themselves and the economy as a whole. Employment outcomes will also depend on the ways necessary investment are being financed.

Results of the econometric analysis at EU27 level

The econometric modelling (carried out by Cambridge Econometrics) considered three different sectoral emission abatement scenarios:

- **INNO:** focusing on electrification, hydrogen deployment and energy efficiency
- **CIRC:** focusing on alternative design, alternative materials and efficiency (corresponds decarbonisation pathway 1 and 2 as described above)
- **CCS:** focusing on the deployment of carbon capture and storage (CCS)

In all of the pathways (scenarios) we considered a mix of several 'technology levers', such as electrification, hydrogen use, biomass, alternative materials, energy efficiency, recycling and CCS. We estimate the weighted abatement cost of these options from the literature, which we use for calculating the investment required and the operation and maintenance costs. Figure 1 provides a high-level overview of the different actions used and the overall composition of the pathways.

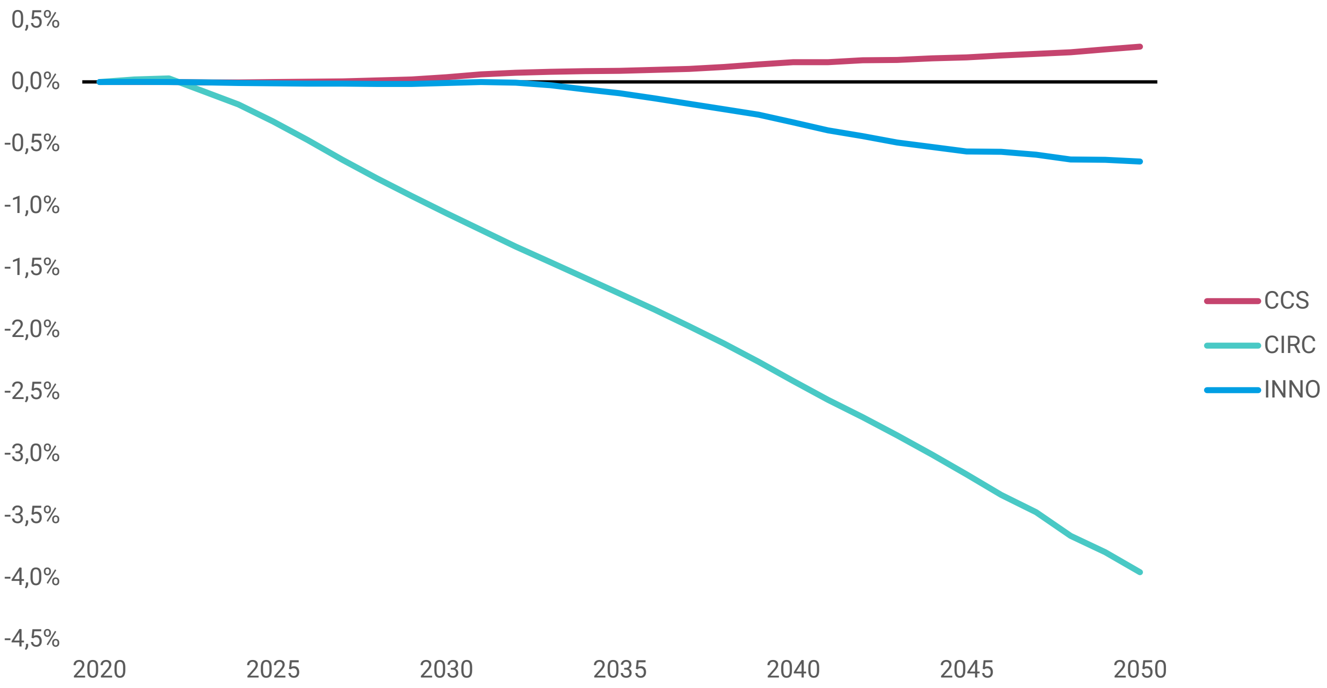
Figure 1 High-level overview of actions used in the decarbonisation pathways

	Innovation led INNO	Circularity and efficiency CIRC	Carbon capture CCS
Electrification	◑	○	◔
Hydrogen use	◑	○	○
Biomass use	◔	◑	◔
Alternative design / materials	○	◑	○
Energy efficiency	◕	●	◔
Recycling	○	◑	○
CCS	◑	○	●

Error! Reference source not found.2 shows an overview of some of the impacts and aspects of the results stemming from a consideration of the decarbonisation pathways featured in the analysis.

The INNO pathway produces slightly negative employment impacts at the level of the wider economy (EU27 aggregate), but EII employment stays positive compared to the reference case. Transformation need is limited – new energy sources and the deployment of innovative technologies that can decarbonise energy use in EII are expected to follow on from increased investment (power generation, new processes, hydrogen production, etc.), balancing out the negative employment impacts of losing government revenues (due to shrinking carbon taxation revenues). Decreasing prices in EII sectors (due to energy cost and carbon cost decreases) raise demand for the sector's products which keeps EII employment high. Country differences are substantial in this case, because the impact is dependent on a number of factors: price impacts and elasticity for EII products; employment changes in energy supply; the overall effect of EII fuel switching; and, finally, the changes in government revenues.

Figure 2. EII employment change compared to naïve net-zero, EU27 (%)



Compared to this, the CCS pathway comes with a more negative economy-wide employment outcome, although EII employment is highly positive in this case. This is explained in that the expected deployment of CCS renders a sectoral transformation unnecessary in this scenario. Nevertheless, it also means that, while government revenues decline (since carbon tax revenues shrink), there is no investment effect (as in the case of INNO) to offset this. While abatement costs are high (stemming from investment into CCS), it is not enough to balance these other forces. Thus the result is an overall decrease in consumption, resulting in employment losses in non-EII sectors. Country-level impacts are rather uniform in this case; however, coal producing and using countries (such as Bulgaria) might respond better. Figure 3 sums up the modelling results according to the three scenarios.

Figure 3 Overview of modelling results (EU27) for the highlighted impacts of the pathways, compared to the reference scenario

	Innovation led INNO	Carbon capture CCS	Circularity and efficiency CIRC
Net labour outcome	Slightly negative	Negative	Slightly positive
EII employment	Slightly positive	Positive	Negative
Labour transformation need	Some transformation	No transformation	High / major transformation
Tax increase / government revenues	Decreasing revenues / slight increase in taxes	Decreasing revenues / slight increase in taxes	Limited change
Gross investment needs	High investment	Limited change	Limited change
Abatement costs	High	Highest	Limited
Country differences	High regional differences	Mostly similar impacts	Some regional differences

The CIRC pathway produces results that are somewhat different from the above two, although our assumptions behind what is happening are rather different as well. Net labour outcomes are slightly positive in this case, but this is an outcome of a large-scale labour market transformation. EII employment shrinks in this scenario but employment in other areas – such as wood-based products, consumption goods and services – increases. This is explained by household savings resulting from the efficiency, consumption and design choices implicit in the scenario. Traditional EII products are assumed to be more long-standing and consumed less, which can release money for consumption in other areas. Due to this type of effect, the changes to government revenues and the investment and abatement costs themselves are rather limited. The country-level impacts are dependent on the strength of the losses in EII sectors and the employment dynamics of those sectors to which consumption is shifting.

All in all, the results of the modelling indicate that high emissions reductions in EII (at close to or above 80 per cent compared to 2010 levels) is possible in multiple ways. However, different pathways yield very different labour and economic outcomes and need different conditions to be fulfilled. In all cases there are major questions regarding their feasibility. Can CCS be deployed on the scale that would be necessary? Is the large-scale labour and sectoral transformation necessary for the CIRC pathway actually possible? Can innovation provide us with technologies to employ hydrogen, increase electrification and introduce new, more carbon-friendly processes in EII? These are questions where further research is necessary to map out the possibilities, costs and opportunities. Meanwhile, attention also needs to be paid to the cross-country differences: while a certain country might be better suited for a given way of decarbonising, the same pathway might create unintended consequences in another.

CBAM effects

This study also modelled a simplified version of a CBAM proposed by the Commission. The simulation assumes that the CBAM is introduced from 2026 and that it covers EII sectors, increasing import prices for third-country goods. It also assumes that revenues, captured through the CBAM, are recycled towards tax measures to maintain budget neutrality.

The simulation results show that, given these assumptions, the CBAM can result in substantial economic and employment gains as it decreases relative prices for domestic production and therefore shifts demand from imports to local production. Meanwhile, the collected and recycled revenues create excess consumption, thus driving the economy and employment, mostly in the services sector. Nevertheless, the results also show that, if the CBAM leads to technological changes (due to increasing factor prices), it can decrease the impacts of the environmental measures via an increase in local emissions.

GDP outcomes by 2050 would be about 0.45 percentage points higher than in a baseline scenario (decarbonization without CBAM), reveals the report which uses the so-called E3ME macroeconometric model developed by Cambridge Econometrics. Considering the introduction of a CBAM system from 2026 onwards, alongside the phasing-out of the current system of free allocations given to emitters, as expected by the European Commission, the simplified CBAM model covers three Energy-intensive industries (EII) which deserve special interest due their large carbon footprints: iron and steel; non-metallic minerals (cement); and chemicals.

The impacts of CBAM also depend on the decarbonization pathways also modelled by the study (innovation /hydrogen/, circular economy and CCS) but are consistent across pathway and time (i.e. they are around an additional 0.27 points GDP increase in 2040 and 0.43-0.45 points by 2050). The main mechanism is that relative prices for domestic production decrease and therefore demand will shift from imports to local production. Meanwhile, the collected and recycled revenues will create excess consumption, thus driving the economy and employment, mostly in the services sector. Nevertheless, the results also show that, due to this increased (rebound) consumption, CBAM can also have a side effect in increasing local emissions.

The employment impacts at macroeconomic level, again demonstrate the substantial positive impacts of the introduction of CBAM across the EU27. Most of the employment gains appear, however, outside the EII sector due to the revenue recycling mechanism. Revenues collected at the level of the Member States from CBAM are recycled towards tax decreases which substantially boost production; this again is complemented with the effects stated above.

While jobs in EII sectors would be maintained CBAM can create up to 230,000 jobs by 2030 and 460,000 by 2040 in the overall EU27 economy due mostly to revenue recycling.

In the current landscape, against the background of new geopolitical and energy policy developments, such as the war between Ukraine and Russia and the resulting REPowerEU package, there are some likely directions on the horizon when thinking about the future of industry. One of these notions is that decarbonisation is becoming a necessity rather than an opportunity, not only because of climate change mitigation but also because energy security concerns make fossil-dependency a heavy burden for EU economies. Therefore fossil-fuelled processes might become simply less realistic and/or more expensive in the future. This could decrease the feasibility of a CCS-focused pathway.

But this does not necessarily mean that these developments favour other pathways. Supply-chain and logistics issues, as well as sanctions against Russia and the disruption of production in Ukraine, might also make it more costly to supply raw materials for European EII. For example, steel production, given that the CIRC pathway employs production from scrap metal, might see limited opportunities if the availability of imported materials shrinks.

Main findings from the country studies

France

In 2005 and for the first time, a specific legal status for electro-intensive companies in France was introduced by law with the aim of facilitating access to electricity and financing the high consumption required by these industries.

The employers insist on the narrative of having a `steel production overcapacity` in Europe as opposed to talk about weak demand. This is the argument commonly used by company management for the capacity closures that have been taking place over the past 20 years. However, the real reasons for these closures have less to do with overcapacity than with strong international competition, progressive replacement of domestic steel by cheaper (and less environmental) imported products (mainly from China), and the relocation of production to countries with lower labour and tax costs by players traditionally based in Europe. These processes have led to a decline in employment (-28% in 2019 compared to 2007) also driven by technological advances that have increased productivity in the sector.

For non-ferrous metals there is a very high demand outlook between now and 2050 for metals such as aluminium, copper, graphite, nickel, cobalt, lithium or manganese, due to the prospects of Li-ion battery use for electric cars. On the other hand, the exorbitant growth in demand calls into question the capacity to extract and supply minerals, raising the prospect of shortages.

The development of the cement sector in France over the last decade has been marked by the sharp decline and weak demand in the construction market since 2008, which has not been able to recover to pre-crisis levels (-29% decrease in production in 2020 compared to 2008).

Looking at dynamics of production, consumption and international trade over the period 1995-2015 in France (Deloitte 2021), confirms there was a progressive deindustrialisation in the EII sectors studied. While there was a decline in industrial production with more than 13,000 jobs lost, the final consumption and imports were growing for most of the sectors. Decarbonisation is also seen as a way to improve carbon footprint through back-shoring. This reindustrialisation scenario would also lead to gains by 2035 of more than €3.7 bn in additional production, leading to 7,883 jobs created or saved

The impact of the CBAM mechanism on the French steel sector would be less important than the impact on the chemical, cement and aluminium sectors, due to the lower percentage of steel imports from outside the EU.

Germany

EII employment in Germany was growing in the past decade (with a Covid dip) but was still 2.5% higher in 2020 than 2010. Forcasts show further growth.

Based on an economtric modelling run for Germany, in the case of the CCS scenario employment impact is somewhat higher (0.8%) than the output impact was, while in the case of the CIRC scenario the labour market impact is less than half (-2.8%) of the economic output effect, while the economic output for the INNO pathway was close to zero, with slightly negative forecast (-0.4%) by 2050.

First, in the CCS scenario employment is largely driven by the steel sector, where CCS based technology is deemed to be more labour intensive, hence the higher gain.

In the INNO scenario there are impacts going in opposite directions. Bottom-up modelling for steelmaking technologies again show gains due to switching to electric and hydrogen based technologies. But, both in the chemicals and in the non-metallic mineral products (NMMP) sectors we observe the opposite: employment is slightly shrinking. In the chemicals sector this is in line with changes in domestic output, while in the NMMP sector despite a growing output (driven by exports), which is in turn explained by prices decreasing EU-wide.

As a summary of the results in EII sectors by 2030 and 2050, as it was discussed, all three pathways reach close to 80% emission reduction from the sectors by 2050. The INNO scenario has overall limited economic and employment impacts in the sector, while the CCS has mostly positive impacts (as investment paying for CCS implementation is flowing in to the sectors, which is followed by investment for operating CCS). Finally, the CIRC scenario, the only pathway that does not depend on technological breakthroughs, has negative economic impacts (within EII sectors) and negative, but lower, employment impacts.

Italy

After Germany, Italy has the second biggest manufacturing base in the EU, both in terms of value added and employment.

Regarding EIIs, chemical industry and metallurgy sectors showed high growth rates in added value in 2019 compared to 2009 (respectively +64.7% and +63.4%). These are followed by the plastics (+45.3%), glass (+39.6%) and pharmaceutical sectors (+38.0%). The data relating to the production of building materials, similar to the construction sector, instead show great difficulty in recovering in relation to the years of the crisis: the added value of the sectors responsible for the production of cement, lime, gypsum, concrete and other building materials showed a significant decline in the decade up to 2019 (-21.9%). The data relating to the cement sector and the production of building materials substantially offer the image of a sector in great difficulty due mainly to the drastic drop in demand.

The development of employment was much more subdued in the past decade, glass and ceramics showed some contraction, while metallurgy saw an 11% loss of jobs over the decade. In 2019, the only sectors to record employment growth are those of the chemical and pharmaceutical sectors (+3.9% and +1.7% respectively). Furthermore, in both sectors, direct employment shows even higher growth rates than in 2009 (+5.9% and +2.3%).

The sector that is most at risk in dealing with decarbonisation processes is that of cement, as it has been exposed for some time to a significant downsizing in production and employment.

There is some confidence in Italy that the ecological transition of the industry, avoiding new closures, will be able to stabilise some of the current jobs and that new ones might also be created, tied to decarbonisation processes. Above all, the focus is on the development of new jobs linked to the circular economy.

Poland

Despite modernisation efforts, the Polish industry remains the fifth biggest emitter and also the fifth most carbon intensive in the EU27 (more than double of the EU average), posing a major challenge. It is strongly related to the size of the Polish economy and rather over-average role of industry in the economy. Important additional factor is the Polish energy mix, still based predominantly on coal and at the same time limited capital (both technological and financial) to modernise the sector.

The last decade a substantial increase in production volume in most of the subsectors was observed. The biggest increase noted in production of diesel oils, by 35,5%, cement clinker by 20,3%, cement by 19,6%, mineral or chemical fertilisers by 18,6% and crude steel by 17,0%. Production of motor and aviation gasoline increased just by 9,0%. The increase in production of practically all selected products indicates their growing demand and the strengthening role of selected sectors in the Polish economy.

The four selected EIIs offer almost 300 thousand jobs, that is 12% of total employment in the whole Polish industry. Almost half of jobs in these four EIIs combined, that is 45% (134 thousand) are in manufacturing of other non-metallic mineral products, 30% (81 thousand) in chemicals and chemical products, 22% (66 thousand) in basic metals and the remaining 5% (14 thousand) in coke and refined petroleum products. Both employment and labour costs were growing in the last decade.

A quantitative analysis (in form of an input–output model) has been carried out to simulate the impact of decarbonisation on EII in terms of 1) total output, 2) demand for intermediate goods and 3) labour market. According to the calculations, total employment in the Polish economy could increase by 450,000 in the period 2025-2030 due to the growth of demand in the following sectors: electrical equipment, machinery and equipment, constructions and construction works. In the period 2035-2040, the number of new jobs are forecast to be around 250,000, and after 2040, at 150,000.

For the broad EII sector the picture is differentiated. Job creation is expected for sectors as “non-metallic mineral products” and “crude petroleum and natural gas; metal ores; other mining and quarrying products”. In the years 2025-2030, up to 20,000 jobs may appear in each of the sectors. The largest decline in employment will be in the sector “Coal and lignite”. Decrease in demand for products from the "Coal and lignite" sector will reduce the number of jobs by an average of 43,000 a year after 2025. The net employment balance of the broad EII sector is expected to develop according to the following pattern: net job growth is foreseen in the first decade until 2030 (with a decreasing net value over the years); between 2030 and 2040 the net job growth in EIIs will be negative.

The biggest challenge for the EII sector in Poland is its high carbon intensity and the huge investment need for decarbonisation. While decarbonisation will have a substantial net positive effect on employment in the total economy, for EIIs jobs losses are expected from the mid 2020-on.

Spain

Like in France the definition of energy intensive industries is clearly set out in law and entitles industrial establishment to preferential electricity price and support mechanisms that are bound to conditions set out by industrial and climate policy objectives.

Looking at the individual sectors, steel has a slow but steady trend towards emission reductions. The decarbonisation of the chemical sector is more complex, as there is smaller increase in GHG when 2005 is taken as the base year. The cement sector shows a significant reduction in emissions, but these can be attributed to the fall in production at national level.

Employment trends in the Spanish steel sector were rather stable in the last decade moving in the range between 21,000 and 22,000 direct employment. The chemical sector is one of the largest and most consolidated sectors in Spain. It is a major economic driving force in Spain: it generates 5.5% of GDP and 3.7% of employment, when indirect and induced employment are taken into account. Both output and employment have been significantly increasing over the last decade with direct employment having reached 234,000 by 2021 (up from 185,000 in 2008). The Spanish cement sector is the leading exporter in the EU and the eighth in the world. It has not been recovering from the collapse suffered during the 2009 financial crisis and although employment levels have been growing since 2014, the 2019 figures (28,900) are a far cry from the 67,700 in 2008.

The biggest challenge of EIIs in Spain is clean electricity access. Despite the progress in renewable energy deployment in Spain, and its significant share of installed capacity, and while EIIs account for significant percentages of total energy consumption across Spain, their shares of renewable energy consumption are practically negligible.

A major obstacle for decarbonising EII-s in Spain will be the concentration of these polluting activities in some geographical areas, which will have to be offered accompanying measures. In other words, the biggest problem for Spain in this transition is geographical inequality.

Jobs and skills are the weak spot in both the policy framework and corporate strategies. At corporate level the strategic plans do not yet take the employment issue into consideration; for the time being, priority is given to industrial and technical investment projects without taking the social issue into account.

In fact, the time being there is no clear idea of the impact of decarbonisation on the number of workers needed to match the new technologies and the foreseen evolutions. On the contrary and with regards to the impact of decarbonization on employment, tasks, skills, and job profiles there is a widespread consensus on several facts: the transition will require a major and sustained reallocation of labour across sectors, occupations and regions; significant investment in re- and up-skilling will be needed.

United Kingdom

All industries in the UK intend to reduce emissions via more efficient use of energy due to improved design, fuel switching which includes increased electrification of industrial processes as well a move towards Energy From Waste (EFW) and hydrogen, changes to raw material inputs and carbon capture of residual emissions. Interviews with glass, steel (chemical) and cement sectors did not foresee many significant changes to labour demand as a result of decarbonisation policies, the general perception was that the attrition of labour had already proceeded as far as was likely in coming years as all industries maintain a lean workforce. Fairly limited changes were foreseen in terms of changes to the day-to-day experience of work and the skills required by workers

The three key strands of industrial decarbonisation policy in the UK are: progress towards the electricity grid decarbonisation which is necessary for the electrification of industrial processes; the emergent hydrogen economy which is crucial for fuel switching and the production of "green steel" and carbon capture and storage (CCS) projects which are being rolled out to capture pre-existing industrial emissions and the emissions associated with hydrogen production from methane (blue hydrogen). Exactly how this will occur varies between industrial sectors discussed in detail by the study. It is important to note that these technological innovative solutions will not be rolled out evenly across the country with some regions benefitting from these technologies well before others. Improvements in energy efficiency and increased circularity of resource use are particularly important for EII sites which fall outside the main industrial clusters as these sites are not likely to gain access to CCS or the hydrogen grid until at the 2040s at the very earliest. This means that exposure to the employment effects of decarbonisation will not be evenly distributed across sectors but will fall more heavily on businesses operating outside the industrial clusters.

Research by the LSE and the University of Leeds assessing 'transition-exposed' jobs based on the calculation of green skills needed within jobs to make the transition happen[2] suggests that over 6 million jobs in the UK will be affected by the transition with around one in five jobs 'in high demand' and a similar proportion 'requiring upskilling' or at risk. This rises to 33 percent of jobs in demand and 17 per cent at risk across UK manufacturing sectors.

Further, the strategy is keen to emphasise that it is 'employer driven' yet there are currently very few employers in the hydrogen and CCS economies despite the criticality of these projects for industrial decarbonisation and the predictions cited above of large numbers of jobs in these sectors. If initiative for initiating skills training lies with employers that do not yet exist it seems likely that we will see severe skills gaps in these and other related areas.