Interim report

'National Ordinance on Measures to Avoid Carbon Leakage in the National Fuel Emissions Trading System' (BEHG Carbon Leakage Ordinance, BECV)

Evaluation Progress Report

by:

Niklas Dürr-Pallin, Victoria Ehlers Arregui, Sandra Heim, Fabian Knödler-Thoma, David Saha, Hannah Schirm, Benno Schöl

Deloitte GmbH Wirtschaftsprüfungsgesellschaft, Berlin

Umwelt Bundesamt

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On behalf of the German Environment Agency

Imprint

Abstract: Evaluation Progress Report – 'National Ordinance on Measures to Avoid Carbon Leakage in the National Fuel Emissions Trading System' (BEHG Carbon Leakage Ordinance, BECV)

The "National Ordinance on Measures to Avoid Carbon Leakage in the National Fuel Emissions Trading System" (BECV) aims to mitigate carbon leakage risks within Germany's national emissions trading system (nEHS). According to the approval under state aid law of the BECV by the European Commission (State Aid SA.63191 (2023/N) – Germany), a comprehensive evaluation of the ordinance is mandated for 2028. Additionally, according to the evaluation report which was presented to the European Commission by the German Federal government for the notification of the BECV, a progress report which includes a complete description of the methodology for the aforementioned evaluation has to be submitted in 2024. The German authorities have committed to implement both reports according to the evaluation plan.

This progress report serves to develop a robust empirical research design for the forthcoming evaluation. It establishes the conceptual and methodological foundation required to determine the BECV's efficacy in preventing carbon leakage while maintaining competitiveness, promoting investments in energy efficiency and climate protection measures, and achieving these goals in a cost-effective manner. As a first step, this report outlines the scope, objectives, and intervention logic of the BECV, delving into the complexities of carbon pricing and the associated risks of carbon leakage. Based on this, the evaluation framework is detailed through targeted evaluation questions and result indicators. In a next step, the report examines relevant methodological approaches to assess the evaluation questions — including econometric, quantitative, qualitative, descriptive, and process-oriented analyses — with a particular focus on econometric (quasi-experimental) methods. The methodological approaches are further aligned with data quality, relevance, and availability; however, the assessment of data sources is limited to currently available data. The actual application of the presented methods therefore highly depends on the data available in 2028.

Kurzbeschreibung: Fortschrittsbericht zur Evaluierung – „Verordnung über Maßnahmen zur Vermeidung von Carbon Leakage durch den nationalen Brennstoffemissionshandel" (BEHG Carbon Leakage-Verordnung, BECV)

Die „Nationale Verordnung über Maßnahmen zur Vermeidung von Carbon Leakage im nationalen Brennstoff-Emissionshandelssystem" (BECV) zielt darauf ab, Carbon-Leakage-Risiken innerhalb des nationalen Emissionshandelssystems (nEHS) in Deutschland zu mindern. Gemäß der beihilferechtlichen Genehmigung der BECV (State Aid SA.63191 (2023/N) – Germany) ist für das Jahr 2028 eine umfassende Evaluierung der BECV vorgesehen. Zusätzlich muss der Europäischen Kommission im Jahr 2024 gemäß dem Evaluierungsplan, den die Deutsche Bundesregierung der Europäischen Kommission für die Notifizierung der BECV vorgelegt hat, ein Fortschrittsbericht eingereicht werden, der eine vollständige Beschreibung der Methodik für die zuvor genannte Evaluierung enthält. Die deutschen Behörden haben sich verpflichtet, beide Berichte gemäß dem Evaluierungsplan umzusetzen.

Dieser Fortschrittsbericht dient der Entwicklung eines robusten empirischen Forschungsdesigns für die anstehende Evaluierung. Er schafft die konzeptionelle und methodische Grundlage, die erforderlich ist, um die Wirksamkeit der BECV zur Verhinderung der Verlagerung von CO_2-Emissionen bei gleichzeitiger Wahrung der Wettbewerbsfähigkeit, der Förderung von Investitionen in Energieeffizienz und Klimaschutzmaßnahmen und der kosteneffizienten Erreichung dieser Ziele zu ermitteln. In einem ersten Schritt beschreibt dieser Bericht die Ziele und die Interventionslogik der BECV und geht dabei auf die Komplexität der CO_2-Bepreisung und die damit verbundenen Risiken für Carbon Leakage ein. Auf dieser Grundlage wird der Evaluierungsrahmen durch gezielte Evaluierungsfragen und Ergebnisindikatoren dargestellt. Im nächsten Schritt werden relevante methodische Ansätze zur

Beantwortung der Evaluierungsfragen - einschließlich ökonometrischer, quantitativer, qualitativer, deskriptiver und prozessorientierter Analysen - bewertet, mit besonderem Schwerpunkt auf ökonometrischen (quasi-experimentellen) Methoden. Die methodischen Ansätze werden darüber hinaus hinsichtlich der Datenqualität, -relevanz und -verfügbarkeit beurteilt, wobei sich die Bewertung der Datenquellen auf aktuell verfügbare Daten beschränkt. Die tatsächliche Anwendbarkeit der vorgestellten Methoden hängt daher stark von den im Jahr 2028 verfügbaren Daten ab.

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CLIMATE CHANGE 'National Ordinance on Measures to Avoid Carbon Leakage **in** the National Fuel Emissions Trading System' (BEHG Carbon Leakage Ordinance, BECV) – Evaluation Progress Report

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List of abbreviations

Abbreviation	Explanation
CO₂	Carbon dioxide
EU-ETS	EU Emissions Trading Scheme
AFiD	Amtliche Firmendaten für Deutschland (Official company data for Germany)
BAT	Best Available Technologies
BECV	National Directive on Measures to Avoid Carbon Leakage in the National Fuel Emissions Trading System (BEHG Carbon Leakage Ordinance (BECV))
BEHG	Brennstoffemissionshandelsgesetz (Germany's Fuel Emissions Trading Act)
BMWK	Bundesministerium für Wirtschaft und Klimaschutz (Federal Ministry for Economic Affairs and Climate Action)
CLI	Carbon Leakage Indicator
CSRD	Corporate Sustainability Reporting Directive
DEHSt	Deutsche Emissionshandelsstelle (German Emissions Trading Authority)
DiD	Difference-in-Differences
FDI	Foreign Direct Investment
IV	Instrumental variable
NACE	Nomenclature statistique des activités économiques dans la Communauté européenne (standardised framework for classifying businesses and economic activities)
nCLI	National Carbon Leakage Indicator
nEHS	Nationales Emissionshandlungssystem (Germany's National Emissions Trading System)
ORBIS	Global company database and information service provided by Bureau van Dijk (Moody's Analytics company)
RDD	Regression Discontinuity Design
SCM	Synthetic Control Methods
UBA	Umweltbundesamt (German Environment Agency)

1   Introduction and Objectives of the progress report

Chapter one presents the structure of this report, outlines its respective objectives, and delineates the scope of the progress report.

According to paragraph 26 (3) BECV ('National Ordinance on Measures to Avoid Carbon Leakage in the National Fuel Emissions Trading System' (BEHG Carbon Leakage Ordinance (BECV)), the Federal Ministry for Economic Affairs and Climate Action (Bundesministerium für Wirtschaft und Klimaschutz – BMWK), which was assigned responsibility for climate protection by decree on 8 December 2021, commissions an external body to evaluate the implementation of the BECV. The German Emission Trading Authority (Deutsche Emissionshandelsstelle – DEHSt) at the German Environmental Agency (Umweltbundesamt – UBA) was entrusted by the BMWK with the tendering and technical support of the commissioning procedure by decree.

As part of the notification procedure of the BECV Germany presented an evaluation plan to the European Commission (henceforth "Commission"). Based on EU state aid law, state aid granted by EU member states must be authorized beforehand by the Commission. As part of the approval of the BECV given by the Commission on 10 August 2023 (State Aid SA.63191 (2023/N) – Germany) the above-mentioned evaluation plan stipulates an evaluation of the BECV in 2028.

According to section 81 of the abovementioned approval granted by the Commission, the German authorities have committed to submit a revised version of the evaluation plan, taking into account the early evidence concerning the implementation of the measure, as part of a first interim report in 2024. The first interim report, (henceforth "progress report" according to the evaluation plan) will include a complete description of the methodology that will be used for the evaluation based on the available data and a preliminary analysis of the measure so far. The final evaluation report will be submitted to the Commission in 2028 and will present the results of the completed evaluation.

The progress report and the final evaluation report will be published on the website of the Federal Ministry for Economic Affairs and Climate Action and on the website of the DEHSt.

Deloitte GmbH Wirtschaftsprüfungsgesellschaft (hereinafter referred to as 'Deloitte') was commissioned by DEHSt in March 2024 as part of a public procurement procedure to carry out the evaluation in accordance with paragraph 26 (3) BECV as well as the progress report on behalf of the BMWK. This document serves as the aforementioned progress report for the evaluation of the BECV. The progress report sets the stage for a more comprehensive evaluation planned for 2028 according to the initially furnished evaluation plan.

The progress report contains 11 chapters and the document is structured as follows:

> ► Chapter 1: Introduction and Objectives of the progress report
>
> ► Chapter 2: Background and brief description of the BECV
>
> ► Chapter 3: Intervention logic of the BECV
>
> ► Chapter 4: Evaluation questions
>
> ► Chapter 5: Evaluation matrix
>
> ► Chapter 6: Result indicators
>
> ► Chapter 7: Analysis methods

1.1   Objective of the progress report

Under a public tender process, Deloitte was commissioned by DEHSt in March 2024 to carry out an evaluation as outlined in paragraph 26 (3) of the BECV. The commission given to Deloitte also includes the preparation of an evaluation report to the European Commission in form of the so-called progress report. The report at hand is the progress report.

The fulfillment of the BECV evaluation plan, initially shared with the Commission during the notification phase, has since become a prerequisite to the BECV's approval. It necessitates the execution of an evaluation and the submission of an associated report by the federal government in 2028. For the said forthcoming evaluation in 2028, the evaluation plan calls for an econometric analysis. The associated report, as detailed in the evaluation plan is anticipated to be part of the paragraph 26 (3) BECV evaluation in 2028, which should be finalized by no later than September 30, 2028.

The focus of the Commission's evaluation process is to utilize econometric methods of policy evaluation to ascertain the efficacy of the BECV. In addition to a quantitative assessment, the BECV evaluation outlined in paragraph 26 (3) BECV also seeks to establish if the BECV requires conceptual adjustments.

This document aims to develop the separate progress report for the Commission, due in 2024, which aims to set the stage for the scheduled evaluation in 2028. Therefore, it elaborates the 2028-evalution's research design – including the empirical methodology, selected research topics, and appropriate result indicators, all in line with the Commission's evaluation plan.

Consequently, the fundamental aim of this report is to establish the conceptual groundwork for the Commission's econometric assessment of the BECV in 2028, with substantial attention given to the development of a fitting research design.

1.2   Scope of the progress report

The evaluation plan for the Commission outlines the following central questions as key elements for the econometric analysis:

1. Does the BECV prevent carbon leakage and protect companies from adverse effects on competitiveness due to carbon pricing? This implies evaluating the effects of the nEHS on the relocation of CO_2 emissions and competitiveness.
2. Do the obligations of the BECV lead to higher investments into energy efficiency or climate protection measures in Germany - thus contributing to emission reductions instead of carbon leakage?
3. Does the BECV achieve these goals in an efficient, cost-effective manner, e.g. by allocating compensation in accordance with actual risk of carbon leakage or by providing an efficient administrative process?

One key aim of this progress report is to further detail, refine, and specify these central questions. Within the context of the forthcoming 2028 evaluation and to answer the

aforementioned evaluation questions, the following methodological and conceptual questions arise:

a)   What are the needs and problems that the BECV intends to address, who are the targeted beneficiaries, what are its general and specific objectives, and what is the expected impact?

b)   What are suitable research questions for the evaluation?

c)   Which result indicators are suitable for answering the evaluation questions?

d)   What methodological approaches and analysis methods are suitable and why?

e)   On what data basis can this be done? What are its limitations?

According to the evaluation plan, a comprehensive assessment of suitable data sources is part of the development of a comprehensive research design. The evaluation should consider the following aspects:

► relevance for the research design, evaluation questions and result indicators

► data quality

► coverage in terms of companies and/or sectors captured

► choice of result and independent variables

► preparation as well as cleaning of raw data and matching of different data sets

Regarding the result indicators, the emphasis should be on potential direct impacts, although the evaluation should also consider indirect impacts such as spillover effects (according to the evaluation plan for the Commission).

The goal of this progress report is thus to develop the empirical approach for the evaluation of the BECV (suitable methodology or empirical approach, incl. data availability) according to the evaluation plan.

The following chapters present this approach and will serve as a basis on which the evaluation by 2028 can be conducted in a separate project.

After a brief description of the BECV, its intervention logic is explained. Then, this report presents the evaluation questions which are subsequently summarised in the evaluation matrix. Thereafter, the result indicators as well as analysis methods and relevant data are described with a particular focus on the econometric methods. The report concludes with a summary of the procedures and timeline until 2028.

2   Background and brief description of the BECV

This chapter describes the intricacies of carbon pricing and the associated risk of carbon leakage, before exploring the foundations and objectives of the BECV in depth.

2.1   Carbon pricing and the risk of carbon leakage

Carbon pricing is a key element in the EU climate policy mix to drive investment into low-carbon technologies and to provide economic incentives for emission reductions. For this purpose, the EU introduced the EU Emissions Trading System 1 (EU-ETS 1) in 2005, under Directive 2003/87/EC, thus creating a market for greenhouse gas emission allowances. The EU-ETS 1 is a so-called "cap and trade" system that sets an annual cap on the total number of emission allowances. The allowance price increases as the cap is subsequently lowered and fewer allowances are allocated. The EU-ETS 1 covers emissions from stationary sources in the energy and industry sectors as well as from entities in the aviation and maritime sectors. Starting in 2021, Germany's National Fuel Emissions Trading Act (Brennstoffemissionshandelsgesetz – BEHG) has established a separate national emission trading system (nationales Emissionshandelssystem – nEHS) that complements the EU-ETS 1 by pricing Germany's fuel-based emissions not covered by the EU-ETS 1. The national system mainly targets emissions from the heating and road transport sectors. It also includes small industrial plants that fall below the capacity thresholds of the EU-ETS 1 and are thus excluded from the latter.

Both systems may have adverse economic effects for companies covered by each respective system. As they pass on the increased costs of the carbon price to their customers, companies that are covered by either system and compete in international markets may experience a deterioration of their competitiveness and thus lose market shares if their competitors are not subject to a similarly high carbon price.

Emission trading therefore involves the risk that certain sectors and subsectors choose to relocate their production activities to regions or countries with less ambitious climate policies, thus increasing emissions in those regions (so called 'carbon leakage'[1]) while eroding the industrial base in their respective economy, i.e. the EU or Germany. According to the report "State and Trends of Carbon Pricing 2024" of the World Bank, the number of carbon pricing mechanisms stands at 75 globally, including 39 carbon taxes and 36 emissions trading systems. Hence, only a limited number of countries have established a national emissions trading system. Within the EU, Austria and Germany have set up a national emission trading system alongside with the EU-ETS 1. As of 2024, about 78% of global emissions are not covered by carbon pricing mechanisms. In addition, approximately 41% of carbon pricing mechanisms have a carbon price below \$20 per ton of CO_2 and the sectors covered by the mechanisms vary widely. Consequently, the scope and pricing within these systems are generally lower and less comprehensive than in the EU-ETS 1 and Germany's national emissions trading systems.

2.2   Concept and objectives of the BECV

According to paragraph 11 (3) BEHG, the Federal Government is authorized to regulate the necessary measures to prevent carbon leakage and to maintain the cross-border competitiveness of affected companies by means of an ordinance that does not require the approval of the Bundesrat but the approval of the Bundestag. The measures are to be implemented primarily through financial support for climate-friendly investments. Based on

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[1] A more nuanced form of Carbon Leakage can occur due to the aforementioned potential loss of market shares to competitors in regions with less stringent climate policy.

this, the BECV was created in order to address the threat of carbon leakage under the nEHS by establishing a compensation scheme that builds on the foundation of the EU-ETS 1 based carbon leakage protection system by adopting the list of sectors and subsectors that are considered to be at risk of carbon leakage. The BECV establishes a direct compensation scheme that can be compared with the so-called electricity price compensation under the EU-ETS 1: Companies can apply to receive state aid for part of the cost increases resulting from the nEHS.

The reason for this systemic difference is that under the EU-ETS 1, companies that own installations are directly regulated, i.e. they directly purchase emission allowances. The nEHS, in contrast, follows a so-called 'upstream approach' that obliges the regulated entity (in this case the distributors such as gas suppliers, coal suppliers or companies in the mineral oil industry, which release the fuels for consumption) to purchase emission allowances (see paragraph 2 BEHG). These increased fuel costs are then passed on along the supply chain to final consumers, such as car owners or owners of industrial plants, that are not regulated by the EU-ETS 1[2]. Since the threat of carbon leakage applies to the companies that own installations and not the fuel distributors, these installation-operating companies can apply for a financial compensation if they pertain to a sector or subsector deemed to be at risk of carbon leakage.

The BECV uses the same list of sectors to be deemed at risk of carbon leakage as the EU-ETS 1 to ensure equal treatment of identical products regardless of whether they are produced in large or small installations. Additionally, it offers the possibility for further sectors to apply for their inclusion in said list if they can prove a risk of carbon leakage via specific criteria (see paragraphs 18 to 21 of the BECV). Companies with emissions that are covered by the nEHS and pertain to sectors on the list can then apply for a partial compensation of their costs of carbon pricing[3]. As in the EU-ETS 1, the compensation amount is weighted by the so-called benchmark approach: Companies that do not employ the best available technology receive compensation for a lower share of their emissions. In addition, the BECV employs sector-specific compensation degrees that range between 65 and 95% (depending on the given sector's emission intensity), and further weigh and reduce each company's compensation amount (see paragraph 7 BECV).

Under the BECV, companies that receive compensation are obliged to demonstrate, from 2023 onwards, that they operate energy or environmental management systems and invest a substantial share of the previously received nEHS-compensation (2023, 2024: at least 50%, from 2025 on-wards: at least 80%) into energy efficiency and climate protection measures (see paragraph 11 (3) BECV). The objective of these investments is to facilitate a gradual reduction in the companies' reliance on fossil fuels, thereby mitigating the potential for carbon leakage associated with the nEHS. This reinstalls the climate protection element that might initially be offset by the BECV and ensures that it continues to concurrently support broader climate protection efforts.

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[2] Double charging of fuel emissions for installations within the scope of EU-ETS 1 can be avoided through advance deduction in accordance with paragraph 7 (5) BEHG in conjunction with paragraph 17 EBeV 2030. In cases where this is not possible, EU-ETS 1 installation operators can offset the double charges that cannot be avoided in advance through subsequent compensation in accordance with paragraph 11 (2) in conjunction with the BEHG Double Balancing Ordinance (BEDV).

[3] The costs of carbon pricing are calculated as the eligible amount of emissions times the respective carbon price.

3   Intervention logic of the BECV

This chapter elaborates the underlying intervention logic of the aid scheme.

The intervention logic is the first step in evaluating the BECV. The logic describes the needs and problems which the BECV intends to address, the target beneficiaries, its general and specific objectives, as well as the expected impact (European Commission 2014).

Thus, the intervention logic provides a structured overview of the general context of the aid by showing the causal effects, the objectives and expected results of the aid scheme. Therefore, the intervention logic serves as a basis for examining the achievement of the objectives of the aid scheme as well as its efficiency and effects.

The following subchapters detail the listed components of the intervention logic[4]:

1. **Baseline situation and principles of the BECV (Baseline Situation)** – What are the contextual (economic, social and environmental) challenges that the BECV aims to address?
2. **Objectives of the BECV and target beneficiaries (General & Specific Objectives)** – What are the general and specific objectives of the BECV? Which target groups are addressed?
3. **Mechanisms and incentives of the BECV (Input & Output)** – Which resources are used for the deployment/implementation of the BECV? What is/was the output of the policy measure under consideration? Which results can be expected from the BECV?
4. **Expected impacts and conclusions (Expected Results & Impact)** – Which short and long-term effects can be expected from the BECV?

A good understanding of the operational aspects of the aid and the overarching objectives is the basic requirement for carrying out the evaluation. During the execution of the order, the evaluation model should be continuously adjusted and refined based on the collected data.

3.1   Baseline situations and principles of the BECV (Baseline Situation)

In the preceding chapters, we have described the carbon pricing mechanism of the nEHS. This mechanism was established with the intention of reducing emissions as well as promoting low-carbon technologies. However, as previously discussed, such a mechanism increases operational costs, potentially leading to industries relocating activities into economies with lower carbon pricing or climate protection requirements and thus causing carbon leakage. This particularly affects sectors that are exposed to strong competitive pressure in the global market. The relocation can take place to locations outside the European Union (in particular to "pollution havens") with lower carbon prices or climate protection requirements or in other European countries without carbon pricing for the heating sector, road transport and small industrial plants. This scenario could disturb the current market equilibrium, making it challenging for German companies to compete in a global market while being subject to more rigid carbon pricing (Partnership for Market Readiness 2015).

In addition, the upstream approach, as employed by Germany's nEHS, places the responsibility on fuel distributors to purchase emission allowances, which in turn results in a significant increase of operational costs throughout the supply chain (DEHSt 2024). This increase in operational costs can have a detrimental impact on smaller enterprises, who may struggle to maintain competitive.

Beyond carbon costs, energy costs constitute a significant additional cost burden for maintaining competitiveness, particularly for industries with high energy consumption. In Germany, energy-

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[4] Figure 2 in chapter 3.4 provides a graphical depiction of the intervention logic as described in the following subchapters.

intensive businesses struggle with rising and fluctuating costs for resources such as electricity (for both fossil and non-fossil sources), oil, and gas. Although electricity costs have fallen again significantly since the end of 2023 following a significant increase in 2022 (BDEW 2024), especially benefiting industrial electricity prices, they remain on a relatively high level compared to other countries (Prognos 2023). The operating and maintenance (O&M) costs for electricity from renewable energies are also higher in Germany than in other countries. For example, O&M costs for onshore wind turbines in Germany are around USD 43/kW per year, which is significantly higher compared to countries such as the USA and Spain, where costs are around USD 26/kW per year (IRENA 2023). This can lead companies, which intend to switch to renewable energies to face additional cost burdens, creating difficulties in reconciling the goals of decarbonisation and competitiveness. In this context of aggregated high cost-pressure for energy-intensive industries the BECV is even more important as it curbs the additional cost burden caused by the nEHS helping firms to maintain their production in Germany

Finally, the transition to low-carbon production modes is not straightforward for all sectors. Industries such as steel, cement and plastics – often termed as 'hard-to-abate' sectors – face significant challenges when they want to reduce their carbon footprint. The path to significant emission reductions for these sectors may require fundamental technological advances, profound financial investments, and adjustments to processes and behaviours (IRENA 2024).

In this fundamentally challenging environment Germany has introduced the aid scheme of the BECV to mitigate the risk of carbon leakage due to the potential impacts of the nEHS. Operating at the level of economic sectors, the BECV aims at providing financial compensations to affected industries.

However, the BECV was not simply designed as an aid scheme but, additionally aims to drive forward the transformation and modernisation of energy-intensive industries.

3.2 Objectives of the BECV and target beneficiaries (General & Specific Objectives)

The BECV aims to counteract the competitive pressure caused by carbon pricing by providing a compensation mechanism that grants financial support and thus largely offsets market disadvantages compared to companies from countries without comparable pricing. As a result, the aim is to prevent distorted market conditions potentially resulting from the carbon pricing so that companies can maintain their domestic operations despite national carbon pricing.

Beyond these economic considerations, the BECV aims to promote a green transformation of the industrial sector and to strengthen the resilience of companies against future increases in CO_2 costs. By incentivizing companies to invest in energy efficiency and climate protection measures, the BECV aims to spur a reduction in energy use and a decarbonisation within the industrial sector. Therefore, it goes beyond a mere compensation measure and aims to incentivise business processes and strategies in line with best environmental practices.

The BECV focuses on sectors that are both emission-intensive and subject to strong international competition. The backbone of the BECV is the list of sectors at risk of carbon leakage. Mostly derived from the EU-ETS 1, this list serves as a keystone for identifying sectors that qualify for the compensation scheme. This targeted approach aims to deliver support precisely where it is needed and offers guidance for companies seeking to apply for compensation under the BECV's scheme. In accordance the BECV has specific provisions that clarify which sectors are eligible for aid.

Smaller industrial facilities, which operate below the capacity thresholds of the EU-ETS 1, fall within the ambit of the BECV's benefits. The respective companies which are typically small and medium-sized companies can encounter the same risks of carbon leakage as larger firms, particularly due to their oftentimes more limited ability to fully pass on increased costs to consumers or absorb these costs. The BECV ensures that such businesses receive support to partially offset the additional cost resulting from the nEHS.

In terms of individual sectors, the main beneficiaries of the BECV are the manufacturing industry with emissions from, for example, the use of fuels for process heat, smelting or internal transportation.

3.3   Mechanisms and incentives of the BECV (Input & Output)

A direct output of the BECV is the compensation granted to companies on the basis of their fuel and heat consumption that is subject to carbon pricing within the nEHS. This compensation represents a direct financial benefit aimed at alleviating the financial burden associated with carbon pricing.

The BECV comprises a variety of mechanisms to counteract excessive demands on the industrial sector and, at the same time, steer it in a climate-friendly direction. Payments are made on the basis of the calculated eligible quantity of emissions, considering the respective degree of compensation and the certificate price of the respective year.

Paragraphs 8 and 9 BECV outline the calculation of the compensation amount, as well as which amounts of fuels and heat usage are eligible for compensation (paragraph 9 (2), (3) and (4) BECV). The following Figure 1 illustrates the various components that are included in the calculation of the amount of compensation.

Figure 1:   Calculation of the compensation to be granted
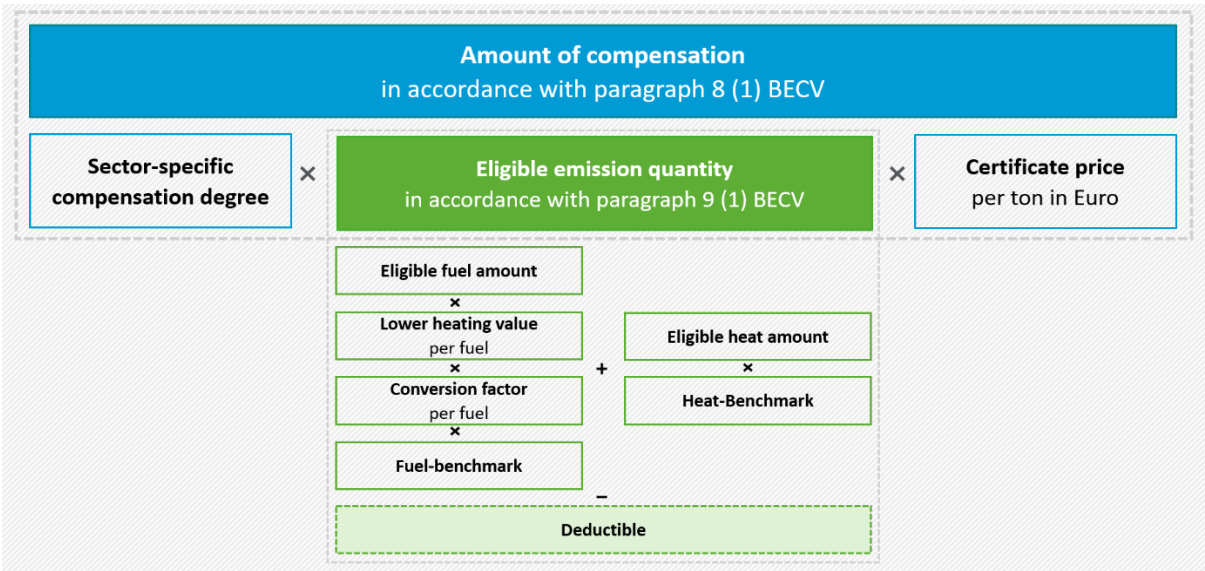
Source: BEHG Carbon Leakage Guideline – Application procedure for the compensation pursuant to paragraph 11 (3) BEHG and BECV – Information for companies on preparing a compensation application. 2024. Own illustration Deloitte (2024.

Firstly, the compensation mitigates a significant proportion of the carbon cost resulting from the nEHS. Companies receive financial support based on their respective fuel and heat consumption. However, this compensation only partially covers the incurred costs. Thus, by not fully compensating the costs of carbon pricing, the financial incentive for companies to reduce their carbon emissions is retained.

Secondly, the degree of compensation is based on the specific burden of the sectors. This nuanced understanding of different sectors extends to the formulation of sector-specific compensation levels. These levels are calculated based on the sector's emissions intensity (CO_2 emissions in kg per Euro of gross value added). The higher the CO_2 costs of a sector in relation to its economic output, the higher the compensation – reflecting the different relative importance of the costs of fuel emissions for different sectors. This tailored approach assigns each sector a specific compensation rate that varies between 65% to 95%, depending on the sector's emissions intensity. This mechanism ensures that the level of aid is matched to the magnitude of challenges faced by each sector (DEHSt 2024b).

Thirdly, the BECV uses concrete benchmarks for both fuels and heat aimed at particularly efficient and low-emission fuel utilisation. When calculating the compensation, only those emissions are considered that are generated by using fuels at the efficiency level of the benchmark. This incentivizes companies to continuously improve towards higher efficiency and lower emissions.

Fourthly, paragraph 10 of the BECV requires companies to establish and maintain energy management systems or environmental management systems as a condition for receiving the compensation. As a result, these systems will become an integral part of the company's business processes. This results in increased integration and application of energy management systems in daily operations supporting transformative efforts.

Fifthly, the BECV requires companies to invest in climate protection measures in return for receiving the aid. Companies that receive aid are therefore obliged to reinvest a proportion of the amount received in energy efficiency. However, according to paragraph 11 of the BECV, required investments are limited to those measures that were identified within the company's respective energy or environmental management system and are deemed economically feasible. According to paragraph 11 (2) BECV, for the years 2023 to 2025, an energy efficiency measure is defined as economically feasible if it achieves a positive net present value within 60% of the investment's assumed economic lifespan (limited to a maximum of 9 years). From 2026 onward, the economic feasibility criterion is extended to a maximum of 90% of an investment's economic life span (without an absolute upper limit). This serves to avoid burdening companies by forcing them to implement uneconomical measures – thereby limiting 'lockup-effects' of economically scarce capital. As an alternative to investments into energy efficiency measures, paragraph 11 (4) BECV offers the possibility to also invest into measures to decarbonize the production process instead – offering companies a wider range of possibilities to transform their business while fulfilling the BECV's requirements. However, while investments in measures of decarbonization do not require considerations of economic feasibility, the possibility to invest into measures of decarbonization is limited to economic sectors for which a benchmark for emissions on the basis of individual products is available (the benchmark needs to be met).[5]

According to paragraph 11 (3) BECV companies are required to reinvest 50% of the previous year's compensation for the years 2023 and 2024. From 2025 onward, the required amount of investment will increase to 80% of the compensation received during the previous year. Through this increasing expectation, the BECV aims to bring about immediate changes in business practices towards sustainability. In parallel, industrial companies could consider options such as retrofitting their production facilities with advanced, energy-saving technology to reduce energy consumption. This favours a shift towards more energy-efficient processes and a more climate-friendly way of operating.

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[5] Directive 2003/87/EG.

Additionally, the BECV offers economic sectors and – in particular economic subsectors – the possibility of a retrospective recognition of their susceptibility to carbon leakage. According to paragraph 19 BECV, business associations and consortia meeting the criteria mentioned in the BECV, can apply for the recognition of economic sectors or subsectors as being at risk of carbon leakage. For this two separate procedures exist. First, paragraph 20 BECV outlines a procedure according to quantitative criteria, in which applicants need to demonstrate their carbon leakage risks based on a specifically defined national carbon leakage indicator (nCLI).[6] Secondly, paragraph 21 BECV specifies a procedure in which applicants need to demonstrate the respective sector's risks of carbon leakage based on qualitative criteria.[7] If an economic sector or subsector successfully applied, companies in these sectors may apply for aid retroactively, under the regular conditions of the BECV's carbon leakage compensation. This approach guarantees that all industries have a chance to demonstrate their susceptibility to carbon leakage and that no companies are excluded from the aid simply because they were not included in the original assessments. As the final approval on the retrospective acceptance of economic sectors within this procedure depends on the approval of the Commission, the procedure is compliant with the European competition regulation and a distortion of the common market is prevented.

Overall, the BECV strengthens both the competitiveness of industry and climate protection. Through its flexible and differentiated mechanisms, it alleviates the financial burden on companies and ensures that they actively shape the transition to a more climate-friendly industry.

3.4   Expected impact and conclusions (Expected Results & Impact)

The BECV is expected to have long-term impacts on the economic, environmental and social performance of the affected industrial sectors. On the one hand, it focuses on maintaining international competitiveness of energy-intensive industries, which should protect Germany from negative adaptation reactions such as carbon leakage and job losses. In addition, the jobs within those sectors subject to the BECV are above-average productive and correspondingly well-paid jobs (Federal Statistical Office 2023). As an instrumental pillar in the implementation of national carbon pricing, the BECV serves to maintain economic stability, particularly in regions that are heavily dependent on energy-intensive sectors. This form of support aims to prevent German businesses from facing a disadvantage against international competitors, particularly those from countries where carbon pricing policies may be less stringent or non-existent. Thus, the BECV can give emission-intensive firms the prospect to be able to continue to operate in Germany besides rising national carbon pricing. This economic security is important because it enables firms to take on otherwise risky long-term investments into transformative climate-friendly technologies inside Germany.

On the other hand, the BECV also keeps climate protection in mind by encouraging companies to invest in climate-friendly and energy-efficient technologies and practices. Thereby, the BECV contributes to a long-term reduction in greenhouse gas emissions and support for environmental sustainability. As the BECV triggers progressive emission reductions, it contributes to the realization of national and global climate protection goals.

The successful implementation of the BECV could also incentivise increased sustainable investment activity and increase consumer demand for products and services from

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[6] The nCLI is calculated as the product of trade intensity and emission intensity of the sector or subsector in accordance with paragraph 20 (2) BECV.

[7] According to paragraph 21 BECV, the risk of relocation is assessed qualitatively based on emission reduction potential, market conditions, and profit margins. These criteria evaluate a company's ability to reduce emissions, the current and future state of the market, and profit margins as indicators for long-term investment or relocation decisions.

environmentally friendly companies. At the international level, the BECV could potentially serve as a model for similar policies in other countries to promote sustainable and balanced industrial development. A successful transition of companies to decarbonisation could attract investors who have sustainable investments in mind and at the same time satisfy the increasing consumer demand for products and services from environmentally friendly companies.

To summarise, the BECV ensures that energy-intensive industries remain competitive while also providing targeted incentives and obligations for climate protection investments. It thus aims to strike a balance between economic resilience and environmental responsibility, a crucial prerequisite for shaping a sustainable future.

Figure 2 provides a graphical depiction of the intervention logic as described in the above subchapters 3.1 to 3.4.

Figure 2: **Intervention logic**

Baseline situation and principles of the BECV	Objectives of the BECV and target beneficiaries	Mechanisms and incentives of the BECV	Expected impacts and conclusions

Baseline Situation	General Objectives	Specific Objectives	Input	Output	Expected Results	Expected Impact

Baseline Situation

Additional burden due to nEHS: The upstream pricing is largely passed on to companies. This leads to higher costs.

Strong competition: Some sectors compete on the world market with suppliers who offer no or a lower carbon price (Pollution Heaven).

Transformation Challenges: Many sectors belong to the "hard-to-abate" sectors that find it difficult to reduce their emissions.

Escalating Energy Costs: In addition to a carbon price, increased energy prices are also driving up the costs of emission-intensive companies.

General Objectives

Prevention of Carbon-Leakage: the migration of companies to other countries due to CO_2 price differences should be prevented.

Preservation of Competitiveness: German companies should remain competitive on the global market.

Specific Objectives

Supporting Vulnerable Sectors: Sectors that are particularly emissions-intensive and highly competitive should be protected, as it is not possible to pass on the price of CO_2.

Boosting Green Investments: Investments in energy efficiency and climate protection should not be reduced despite the compensation payments.

Encouraging Best Practices: The BECV ties higher compensation to the deployment of the best available technologies, acting as a strong incentive for businesses to incorporate more environment-friendly practices.

Input

Sector-Dependent Aid: Only sectors that exceed the carbon leakage criterion are eligible for aid.

Sector-Specific Compensation Grades: Sectors are allocated a compensation grade of between 65-95% based on their emissions intensity per euro of gross value added.

Post Factum Recognition of Sub-Sectors: Sub-Sectors can also be admitted to aid at a later date if they can prove that they exceed the carbon leakage criterion.

Mandatory Investments in Energy and Climate Protection Measures: Companies that receive compensation payments must invest 50% (later 80%) of these.

Output

Financial Relief for Companies: Companies are compensated according to their fuel consumption.

Energy Efficiency Investments: The BECV requires companies to invest in specific measure enhancing energy efficiency, ensuring improved performance and greater environmental responsibility.

Climate Protection Investments: The BECV mandates businesses to allocate a portion of received aid towards climate protection measure, fostering a shift towards more environmentally sustainable operations.

Expected Results

Reduction in Cost Pressures: Companies not only experience less cost pressure due to carbon pricing bur are also less likely to relocate their operations.

Surge in Sustainable Investments: Due to mandatory investments in energy efficiency and climate protection measures, these have increased.

Expected Impact

Business Retention and Carbon-Leakage Prevention: Germany becomes a more attractive location, with fewer companies moving jobs and production.

Enhanced Competitiveness: Due to the compensation payment, German companies are more competitive.

Increase in acceptance of transformative industrial policy: Through active support of businesses, companies are more open to further measures.

Emissions Reduction: Investments in energy efficiency lead to fewer greenhouse gas emissions.

Industry Innovation: BECV could spur technological innovation and efficiency in businesses.

Increased Appeal: BECV boosts investor and consumer interest through green transitions.

Policy Inspiration: BECV's strategies could inspire similar global policy adoption.

Source: Own illustration, Deloitte (2024).

4 Evaluation questions

Based on the intervention logic, this chapter presents the evaluation questions for the underlying evaluation.

Building upon the intervention logic defined in the previous Chapter 3, specific evaluation questions have been derived in the following chapter. Using the intervention logic as a foundation facilitates measurements of effectiveness on several tiers and incorporates a clear, methodical approach for data collection and analysis.

The scope of the evaluation is determined by the evaluation plan which encompasses explicit questions that are to be resolved quantitatively and substantiated with appropriate evidence. The questions shared concentrate on the influence of the state aid scheme and can be organised into three levels (European Commission 2014):

1. Direct impact of the aid on beneficiaries
2. Indirect impact of the aid scheme
3. Proportionality and appropriateness of the aid scheme

The evaluation aims to analyse the effect of the aid scheme across all three tiers. Usually, the most robust measurements can be taken from the aid's direct impact on its recipients. Most of the existing evaluation methodologies were developed to answer such questions. In addition, assessing the direct consequences of the aid, including the stimulus effect[8], is crucial since it can shed light on potential indirect effects and expected distortions. Especially when the aid fails to provide a stimulus effect, the aid is probably causing distortions by resulting in unexpected profits for the beneficiaries.

In the context of analysing the effects of the BECV, the evaluation provides information on whether and to what extent the BECV has achieved its objectives. For this purpose, the following guiding evaluation questions were developed: Does the BECV

(i) prevent carbon leakage and adverse effects on businesses' competitiveness;

(ii) lead to investments into energy efficiency or climate protection measures; and

(iii) achieve these goals in an efficient, cost-effective manner?

However, as described in Chapter 2, the degree to which the evaluation can answer these questions will depend on the final research design, chosen for the evaluation in 2028. For instance, an ex-post evaluation using econometric methods to assess evaluation question (ii) may not be possible due to a lack of company-level data on energy efficiency and/or emissions or the lack of a suitable control group, as indicated in the evaluation plan for the Commission.

In the following sections, we will delve into evaluation questions based on the intervention logic (see Chapter 3) and the approved questions from the evaluation plan. These questions have been further developed and organised into the three categories as a guideline for the evaluation process in 2028.

4.1 Evaluation questions to analyse the direct impact

The direct effect is defined as the impact of the intervention on the primary direct objectives. In case of the BECV, these are the prevention of carbon leakage alongside with the preservation of competitiveness of German industries.

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[8] Refers to the broader, often secondary impact that a policy intervention has on the economy. It is typically aimed at boosting economic activity by encouraging employment, investments, and overall economic growth.

In terms of carbon leakage, the central issue to evaluate is whether the BECV successfully prevents companies from reducing or relocating their operations to areas with less stringent carbon pricing regulations. In terms of competitiveness, the evaluation should assess whether the BECV has helped affected German industries to maintain their competitive positions in a global market.

Accordingly, evaluation questions testing the direct effect of the measure investigate whether the aid has successfully led to the prevention of carbon leakage[9], preserved the competitiveness of German industries and led to a rise in investments in energy efficiency and climate protection measures. The aid is considered to not have been effective in achieving the intended result if businesses would have engaged in the activity regardless or with lower state aid. Hence, the outcome could have been achieved with less or even without any intervention (Farrel, N. 2022).

The following questions should therefore be asked:

1. Whether and to what extent did the BECV achieve its objectives? (target achievement)
   1.1 Which impact does the BECV have on Carbon Leakage?
   1.2 Which impact does the BECV have on competitiveness?
2. Whether and to what extent does the BECV have an impact on climate protection? (target achievement)
   2.1 Did the BECV lead to higher investments in energy efficiency and climate protection measures of companies in the sectors affected by the BECV compared to similar companies in sectors not affected by the BECV?
   2.2 Which impact do investments in energy efficiency and climate protection measures under the BECV have on the emissions of the companies concerned?
3. How can the effects be classified and evaluated in an overall economic view?
4. Have beneficiaries been affected differently by the BECV? Is there a difference in the effects regarding company size and location (e.g. East vs. West; small vs. large)?
5. Has the aid significantly affected the behaviour of the beneficiaries? (incentive effect)
6. To what extent was the BECV responsible for the overall effects that have been achieved?

4.2 Evaluation questions to analyse the indirect impact

Indirect effects are defined as secondary effects like spillover effects caused by primary changes in behaviour and activities among aid recipients. Indirect effects may display both positive and negative characteristics. Within the framework of climate and energy policy, these could manifest as impacts on a third party or unforeseen effects on the intended recipient. Positive indirect effects frequently occur when there's a harmonious connection with other initiatives (Farrel, N. 2022).

Given that there is no fixed aid threshold at the company level, the potential for intra-sectoral spillover effects, such as the spread of technology, knowledge, and productivity gains from one company to other companies, is reduced. Furthermore, companies in sectors eligible for aid primarily compete within their respective sector. Assuming that companies within an eligible sector receive the same compensation factor, distortion of competition between companies within a sector is less likely. However, there could be spillovers to other sectors in the value chain, for example, because remaining costs after receiving the compensation are passed through or because the passed-through costs are lower than without the BECV.

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[9] Using the broader definition of carbon leakage, which also includes changes in employment, production, investment and other economic indicators.

The identified potential indirect effects of the BECV shall be evaluated with the following evaluation questions:

1. Has the scheme contributed to the relevant policy objective? How do specific design choices of the BECV contribute to this? (impact monitoring)
2. What impact does the BECV have on the trade activities of affected sectors? (impact monitoring)
3. What impact does the BECV have on downstream value chains? (impact monitoring)

4.3   Evaluation questions to analyse the proportionality and appropriateness

The last set of questions focuses on how the proportionality and appropriateness of the BECV should be analysed, ensuring it is balanced and suitable to meet the desired policy objectives.

The evaluation of the proportionality and appropriateness of the BECV aims to examine potential improvements in the design of the aid scheme. Particularly, it should assess its operational appropriateness, including the implementation processes, whether the compensation scheme fits the needs of aid recipients, and the actual administrative costs. The evaluation strives to understand if the current compensation measure requires qualitative or quantitative adjustment and how this scheme compares to other forms of carbon leakage protection measures.

The following questions should be analysed to examine the proportionality and appropriateness of the BECV:

Proportionality

1. Could potential BECV design changes improve results? (policy design)
2. Are the processes for implementing the programme on target? (policy design)
3. To what extent does the BECV contribute to carbon leakage protection in the future? (policy design)

Appropriateness

1. To what extent do the operational programme implementation and the compensation scheme meet the requirements of the aid recipients? (cost effectiveness)
2. What are the actual administrative costs and what share do they have in the overall budget of the BECV? (cost effectiveness)
3. Is a (qualitative / quantitative) adjustment of the current compensation measure necessary and useful? (cost effectiveness)
    3.1   What effect does a higher carbon leakage risk (measured through the Carbon Leakage Indicator (CLI)) have on the compensation payment (level of compensation)?
    3.2   Does a higher compensation payment/higher compensation level lead to higher carbon leakage protection?
4. What is the benefit of the BECV in relation to other compensation schemes / carbon leakage protection schemes? (cost effectiveness).

5   Evaluation matrix

In accordance with common practice and international evaluation standards (including those from the EU Better Regulation Guidelines and the OECD), a targeted evaluation matrix has been developed.

The Evaluation Matrix contains evaluation questions that specify and operationalise the different evaluation criteria for the BECV. For each evaluation question, qualitative and quantitative indicators have been defined that serve to measure the evaluation questions and evaluation criteria, respectively.

Furthermore, the evaluation matrix defines all data needs and data collection methods. This approach ensures a structured data collection and a substantiated, well-founded basis for the analysis. Details on result indicators, analysis method and data sources are described in Chapters 6-8.

Table 1:   **Evaluation Matrix**

#	Evaluation Question	Result Indicators	Data Sources[10] – Sector-level	Data Sources – Company-level	Analysis Method
Direct effects					
Target achievement					
D.1	Whether and to what extent did the BECV achieve its objectives? (Target achievement)				
D.1.1	What impact does the BECV have on the reduction of Carbon Leakage?[11]	▶ Direct emissions, emission intensity ▶ Production value ▶ Value added ▶ Revenues ▶ Employees ▶ FDI (Foreign Direct Investments) ▶ Tangible fixed assets	**Germany** ▶ **Destatis** - <u>Energieverwendung im Verarbeitenden Gewerbe (43531)</u> - Standardfaktoren (DEHSt-Liste) - <u>Investitionserhebung (42231)</u>	**Germany** ▶ **AFiD** - Modul: <u>Energieverwendung</u> - <u>AFiD-Panel Industrieunternehmen (Kostenstrukturerhebung und Investitionserhebung)</u> **European Countries**	**Joint policy effect**[12] - Matched Difference-in-Differences (DiD) **BECV effect**[13] - Regression Discontinuity Design (RDD) - Matched DiD - Synthetic Control Method (SCM)

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[10] Distinction between German and European data sources for indicators: European data is required for the European control group to measure the joint policy effect when applying the DiD method.

[11] Using the broader definition of Carbon Leakage, which also includes changes in employment, production, investment, and other economic indicators.

[12] The joint policy effect refers to the impact of the existing nEHS in combination with the BECV compensation scheme.

[13] The BECV effect refers to the additional impact of the BECV compensation mechanisms beyond what is achieved by the nEHS.

#	Evaluation Question	Result Indicators	Data Sources[10] – Sector-level	Data Sources – Company-level	Analysis Method
		▶ Emission costs/value added	- Kostenstrukturerhebung (42251) - Produktionserhebung (42131) - Price for emission certificates (Paragraph 10 BEHG) **European Countries** ▶ **Eurostat** - Energy statistics - Annual detailed enterprise statistics for industry - Balance of payments - International transactions	▶ **ORBIS (Financial metrics)** ▶ **National Statistics Offices**	
D.1.2	How and to what extent does the BECV impact competitiveness?	▶ Market share (revenues) ▶ Market concentration (Herfindahl-Hirschman Index (HHI)) ▶ Market power (Lerner Index) ▶ Innovation rate (patents, etc.) ▶ Trade surplus ratio ▶ Domestic market share (domestic production - exports) / (domestic production - exports + imports) ▶ European market share (German production - German Non-EU exports) / (German production –	**Germany** ▶ **Destatis** - Investitionserhebung (42231) - Kostenstrukturerhebung (42251) - Produktionserhebung (42131) - Aus- und Einfuhr (Außenhandel) (51000) **European Countries** ▶ **Eurostat** - Annual detailed enterprise statistics for industry - Community innovation survey 2020 - International Trade in goods	**Germany** ▶ **AFiD** - AFiD-Panel Industrieunternehmen (Kostenstrukturerhebung und Investitionserhebung) - AFiD-Panel Außenhandelsstatistik **European Countries** ▶ **ORBIS (Financial metrics)** ▶ **National Statistics Offices**	**Joint policy effect** - Matched Difference-in-Differences (DiD) **BECV effect** - Regression Discontinuity Design (RDD) - Matched DiD - Synthetic Control Method (SCM)

#	Evaluation Question	Result Indicators	Data Sources[10] – Sector-level	Data Sources – Company-level	Analysis Method
		German Non-EU exports + Imports) ▶ Total Factor Productivity ▶ Cost pressure indicator (emission costs/revenues)			
D.2	Whether and to what extent does the BECV have an impact on climate protection? (Target achievement)				
D.2.1	Did the BECV lead to higher investments in energy efficiency and climate protection measures of companies in the sectors affected by the BECV compared to similar companies in sectors not affected by the BECV?	▶ Investments in energy efficiency ▶ Investments in climate protection ▶ Production volume as a proxy for energy consumption ▶ Energy consumption (at sector level only)	**Germany** ▶ **Destatis** - Energieverwendung im Verarbeitenden Gewerbe (43531) - Standardfaktoren (DEHSt-Liste) - Produktionserhebung (42131) - Erhebung der Investitionen für den Umweltschutz (32511) - Laufende Aufwendungen für den Umweltschutz im Produzierenden Gewerbe (32521) ▶ **BECV regulatory data (DEHSt)** **European Countries** ▶ **Eurostat** - Energy statistics Annual detailed enterprise statistics for industry	**Germany** ▶ **AFiD** - Modul: Energieverwendung - Modul: Umweltschutzinvestitionen - AFiD-Panel Industrieunternehmen (Kostenstrukturerhebung und Investitionserhebung) ▶ **BECV regulatory data (DEHSt)** **European Countries** ▶ **ORBIS (financial metrics)** ▶ **National Statistics Offices**	**Joint policy effect** - Matched Difference-in-Differences (DiD) **BECV effect** - Regression Discontinuity Design (RDD) - Matched DiD - Synthetic Control Method (SCM) - (IV approach)

#	Evaluation Question	Result Indicators	Data Sources[10] – Sector-level	Data Sources – Company-level	Analysis Method
			- <u>Environmental protection expenditure</u>		
D.2.2	What impact do investments in energy efficiency and climate protection measures under the BECV have on the emissions of the companies concerned?	▶ Energy intensity (Total energy consumption / value added or revenues or production volume) ▶ Emission intensity (Total emissions / value added or revenues or production volume)	**Germany** ▶ **Destatis** - <u>Energieverwendung im Verarbeitenden Gewerbe (43531)</u> - Standardfaktoren (DEHSt-Liste) - <u>Investitionserhebung (42231)</u> - <u>Kostenstrukturerhebung (42251)</u> - <u>Produktionserhebung (42131)</u> **European Countries** ▶ **Eurostat** - <u>Energy statistics</u> - <u>Annual detailed enterprise statistics for industry</u>	**Germany** ▶ **AFiD** - <u>Modul: Energieverwendung</u> - <u>AFiD-Panel Industrieunternehmen (Kostenstrukturerhebung und Investitionserhebung)</u> **European Countries** ▶ **ORBIS (Financial metrics)** ▶ **National Statistics Offices**	**Joint policy effect** - Matched Difference-in-Differences (DiD) **BECV effect** - Regression Discontinuity Design (RDD) - Matched DiD - Synthetic Control Method (SCM) - (IV approach)
D.3	How can the effects be classified and evaluated in an overall economic view?	▶ Qualitative comprehensive assessment based on findings from D.1, including an assessment of the cost pressure indicator	N/A	N/A	▶ Comprehensive qualitative assessment
D.4	Have beneficiaries been affected differently by the BECV? Is there a difference	▶ Quantitative (econometric) analysis using the indicators from	See D.1	See D.1	**Joint policy effect** - Matched Difference-in-Differences (DiD)

#	Evaluation Question	Result Indicators	Data Sources[10] – Sector-level	Data Sources – Company-level	Analysis Method
	in the effects regarding company size and location (East vs. West; small vs. large)?	D.1 with different dummy/ interactive variables for company size and location			**BECV effect** - Regression Discontinuity Design (RDD) - Matched DiD - Synthetic Control Method (SCM) Including a different dummy/ interactive variable for company size and location
D.5	Has the aid significantly affected the behaviour of the beneficiaries? (Incentive effect)	▶ Qualitative assessment of the behaviour of the companies receiving aid on the basis of interviews (capturing the business or company perspective)	N/A	N/A	▶ Qualitative assessment
D.6	To what extent was the BECV responsible for the overall effects that have been achieved?	▶ Qualitative assessment based on the findings from D.1	N/A	N/A	▶ Qualitative assessment
Indirect effects					
Impact Monitoring					
I.7	Has the scheme contributed to the relevant policy objective? How do specific design choices of the BECV contribute to this? (Impact monitoring)	▶ Qualitative assessment of the BECV design as well as the interrelationships and potential effects on target achievement	N/A	N/A	▶ Qualitative assessment

#	Evaluation Question	Result Indicators	Data Sources[10] – Sector-level	Data Sources – Company-level	Analysis Method
I.8	What impact does the BECV have on the trade activities of affected sectors? (Impact monitoring)	▶ Imports (EU; non-EU) total and as a share of the domestic market ▶ Exports (EU; non-EU) total and as a share of the global market ▶ Trade Surplus	**Germany** ▶ **Destatis** - Aus- und Einfuhr (Außenhandel) (51000) **European Countries** ▶ **Eurostat** - International Trade in goods - Gross domestic product (GDP)	**Germany** ▶ **AFiD** - AFiD-Panel Außenhandelsstatistik **European Countries** ▶ **ORBIS (Financial metrics)** ▶ **National Statistics Offices**	**Joint policy effect** - Matched Difference-in-Differences (DiD) **BECV effect** - Regression Discontinuity Design (RDD) - Matched DiD - Synthetic Control Method (SCM)
I.9	What impact does the BECV have on downstream value chains?	▶ Passed-through costs in non-BECV sectors	▶ **Destatis** - Input-Output-Tabelle (81511)	N/A	▶ Quantitative assessment
Proportionality and appropriateness					
Policy design					
P.10	Can potential BECV design changes improve results? (policy design)	▶ Qualitative analysis of the BECV design as well as the potential effects on target achievement	N/A	N/A	▶ Qualitative assessment
P.11	Are the processes for implementing the programme on target? (policy design)	▶ Qualitative process analysis of the BECV implementation process	N/A	N/A	▶ Qualitative assessment
P.12	To what extent does the BECV contribute to carbon leakage protection in the future? (policy design)	▶ Qualitative assessment based on the findings from D.1	N/A	N/A	▶ Qualitative assessment
Cost effectiveness					

#	Evaluation Question	Result Indicators	Data Sources[10] – Sector-level	Data Sources – Company-level	Analysis Method
A.13	To what extent do the operational programme implementation and the compensation scheme meet the requirements of the aid recipients? (cost effectiveness)	▶ Qualitative assessment of the opinions of aid recipients on the adequacy and effectiveness of the operational programme and compensation scheme	N/A	N/A	▶ Qualitative assessment
A.14	What are the actual administrative costs and what share do they have in the overall budget of the BECV? (cost effectiveness)	▶ BECV budget ▶ Administrative costs BECV	▶ **BECV regulatory data (DEHSt)**	▶ **BECV regulatory data (DEHSt)**	▶ Quantitative (descriptive) assessment
A.15	Is a (qualitative / quantitative) adjustment of the current compensation measure necessary and useful? (cost effectiveness)				
A.15.1	What effect does a higher carbon leakage risk (CLI) have on the compensation payment (level of compensation)?	▶ BECV budget ▶ Allocated BECV compensation ▶ Total auction volume nEHS ▶ Compensation as % of total auction volume nEHS ▶ Emission costs/value added (with and without the BECV)	▶ **BECV regulatory data (DEHSt)** ▶ **Destatis** - Investitionserhebung (42231) - Kostenstrukturerhebung (42251)	▶ **BECV regulatory data (DEHSt)** ▶ **AFiD** - AFiD-Panel Industrieunternehmen (Kostenstrukturerhebung und Investitionserhebung)	▶ Quantitative (descriptive) assessment
A.15.2	Does a higher compensation payment/higher compensation level lead to higher carbon leakage protection?	▶ Quantitative (econometric) analysis using the indicators from D.1	See D.1	See D.1	**Joint policy effect** - Matched Difference-in-Differences (DiD) **BECV effect**

#	Evaluation Question	Result Indicators	Data Sources[10] – Sector-level	Data Sources – Company-level	Analysis Method
					- Regression Discontinuity Design (RDD) - Matched DiD - Synthetic Control Method (SCM) Including interactive variable for compensation level
A.16	What is the benefit of the BECV in relation to other compensation schemes / carbon leakage protection schemes? (cost effectiveness)	▶ Qualitative assessment of the benefits of the BECV compensation scheme compared to other compensation schemes using aid intensity (Allocated compensation/value added; allocated compensation/ employees) as a comparison indicator with other compensation schemes	▶ **BECV regulatory data DEHSt** ▶ **Destatis** - Investitionserhebung (42231)	▶ **BECV regulatory data DEHSt** ▶ **AFiD** - AFiD-Panel Industrieunternehmen (Kostenstrukturerhebung und Investitionserhebung)	▶ Qualitative (quantitative) assessment

Source: Own illustration, Deloitte (2024).

6   Result indicators

This chapter categorises the proposed result indicators to the evaluation questions derived in Chapter 4.

The result indicators are intended to quantitatively assess the direct and indirect effects of the BECV as well as the proportionality and appropriateness of the BECV, thus answering the evaluation questions.

Following the evaluation plan, the result indicators are categorised into three objectives aligning with the fundamental research questions (see Chapter 4):

> (i) carbon leakage and competitiveness,
>
> (ii) climate protection, and
>
> (iii) cost-effectiveness.

Objective (i) covers the reduction of carbon leakage risks and negative competitiveness effects stemming from the nEHS, captured by the result indicators such as value added, production volume, revenues, number of employees, market share and foreign direct investments (FDIs). Objective (ii) includes a reduction in emissions and contribution to the transition towards low-carbon technologies, enhancing resilience against carbon leakage, increasing climate protection, and promoting investment in energy efficiency activities. Result indicators to measure objective (ii) include direct emissions, direct emission intensity, energy efficiency and investments in climate protection and energy efficiency measures. Objective (iii) aims to ensure cost-effective carbon leakage protection, reflected by the result indicators of the BECV budget, allocated BECV compensation, administrative costs, total auction volume nEHS and compensation as a percentage of total auction volume nEHS.

7   Analysis methods

In this chapter, we discuss several methods suitable for the evaluation of the fundamental research questions introduced in Chapter 4.

We start with an overview of econometric methods, followed by quantitative, qualitative, and descriptive methods as well as process-oriented methods. By the end of each sub-section, we list the relevant evaluation questions for each described method.

7.1   Econometric methods

Randomised experiments such as randomised controlled trials are the gold standard in evaluation research (European Commission 2014). However, they are not applicable in this context, as selection into the BECV compensation scheme is not random, but the result of sector-specific eligibility criteria. Therefore, to determine the causal effect of the BECV compensation on the recipients from an ex-post-perspective, quasi-experimental methods are needed. The presented methods can be combined, the actual application of a method however highly depends on the available data (see Chapter 8).

To answer the evaluation questions aiming at evaluating the direct impacts of the BECV, a clear identification strategy is needed. We suggest a distinction between two effects:

1.   The effect of the nEHS in combination with the BECV (joint policy effect)
2.   The effect of the BECV compensation scheme (BECV effect)

The **joint policy effect** refers to the impact of the existing nEHS in combination with the BECV compensation scheme. Essentially, it identifies the effects of the combined policy mix that affects German manufacturing industries in the wake of the introduction of the nEHS combined with the BECV. The **BECV effect** refers to the influence of the BECV compensation mechanism. The BECV effect seeks to quantify the additional impact introduced by the BECV, including adjustments in production, employment, or changes in emissions patterns resulting directly from the implementation of the BECV. In summary, the joint policy effect indicates the direction and magnitude of the policy mix impact of the nEHS and the BECV, whereas the BECV effect isolates the specific impact of the BECV compensation scheme. By analysing the BECV effect separately, we can determine its contribution to changes in outcomes. Analysing both effects allows for a more comprehensive assessment of the impact and effectiveness of the BECV policy.

First, the joint policy effect should be identified with the help of the EU control group in a DiD setting. Secondly, the BECV effect should be identified with the help of one of the three methods presented subsequently. For each effect, a separate regression needs to be estimated. In each regression, the respective indicator will be the dependent variable and the joint policy effect, respectively the BECV effect, will be given by the coefficient β for the interaction term (see specification below).

In the following, we recommend a matched Difference-in-Differences (DiD) method for analysing the joint policy effect and present three methods for assessing the BECV effect.

Joint policy effect

DiD is an econometric technique used to estimate causal relationships. The method is based on comparing the development of the outcome between a treatment group (manufacturing sectors/companies affected by an nEHS with a carbon leakage compensation scheme = BECV sectors/companies in Germany) and an appropriate control group unaffected before and after the intervention (same manufacturing sectors or companies as BECV sectors in EU countries without a national ETS and a carbon leakage compensation scheme). The effect of the

intervention (nEHS with BECV) can be estimated under the identifying assumption that in the absence of the intervention, the treatment group and the control group would have followed parallel paths over time (parallel trends assumption). In other words, the difference in outcomes between the treatment and control groups would remain constant over time if the intervention had not occurred.

The DiD approach can be combined with matching procedures, such as propensity score matching, to create a more accurate control group. This combined method, known as **matched DiD**, involves using matching techniques before applying the DiD analysis. **Propensity score matching** involves matching treated and untreated units with similar propensity scores, which are the probabilities of receiving the treatment given observed characteristics. Each treated company or sector is matched with one or more non-treated companies or sectors based on a set of observable characteristics. Then, the DiD approach is applied using only the matched non-treated companies or sectors as a control group. Treated units which did not find a neighbour can be excluded.

Matched DiD has several advantages, including its ability to control for unobserved, time-invariant effects, thus eliminating confounding effects assuming they remain constant over time. Additionally, a well-chosen control group can reduce the need for including numerous control variables. However, this method also has notable drawbacks. Identifying an appropriate control group is challenging, and the parallel trends assumption—where the treatment and control groups are expected to follow similar trends in the absence of treatment—must hold true. Furthermore, the characteristics of the control group may change over time, potentially undermining the validity of the comparison in retrospect.

In the context of the BECV evaluation, a matched DiD approach might be best suited for evaluating the joint policy effect of the nEHS with the BECV. The matched DiD approach can be used to analyse whether and to what extent emissions and competitiveness of sectors (or companies) affected by an nEHS with BECV change compared to those sectors or companies in countries without an nEHS and a respective carbon leakage compensation scheme.

To identify the joint policy effect, we therefore suggest establishing an **EU control group** by using sectors or companies in EU countries that have not introduced a national emissions trading system (or similar carbon pricing instruments) for CO_2 emissions and a compensation scheme to prevent carbon leakage similar to the BECV. Generally, all manufacturing sectors or companies in EU countries might be considered - except those in Austria, which has an nEHS and compensation scheme to prevent carbon leakage. EU countries without an nEHS but with a carbon tax can also be included in the control group, provided the carbon tax was introduced at a different time than the German nEHS. In such cases, a simple dummy variable can control for the effects of the national carbon tax. Companies or sectors in structurally similar countries, particularly those in Central Europe and neighbouring countries with a high prevalence of small and medium-sized companies, such as Italy, are viable comparison groups.

After identifying these countries, the same sectors as those eligible for the BECV compensation in Germany will be identified. Suitable comparison partners will be matched and compared based on various observable characteristics such as emissions, company size, revenues, and number of employees. Matching can be conducted on a sector as well as on a company level. If the matching is executed at the company level, we recommend exact matching for a company's sector to increase the validity of the results. Exact matching ensures that companies in the treatment and control groups are not only similar in baseline characteristics but belong to identical sectors, thereby enhancing the credibility of causal claims. If matching is performed on a sector level, propensity score matching, as previously described, can be used to identify the

most suitable comparison partners for the German BECV sectors within the respective EU sectors. Considering these matching procedures, we can infer that the manufacturing sectors in Germany eligible for BECV and the exact same sectors in other EU countries are likely to share similar trends in outcome variables. Therefore, we expect the parallel trend assumption to hold and that the requirements for the application of the DiD approach are fulfilled.

In the following, the DiD approach for analysing the joint policy (nEHS + BECV) effect will be specified with a treatment dummy = 1 representing German manufacturing sectors eligible for BECV and a treatment dummy = 0 representing European manufacturing sectors (exact same sectors as those eligible for BECV in Germany) without an nEHS and carbon leakage compensation schemes. Additionally, for this method and all subsequent methods, control variables related to the energy crisis, such as energy prices, should be included to more accurately isolate its impact on the German energy-intensive industry.

A typical DiD specification in this context would have the following functional form:

$$Y_{it} = \alpha + \beta(Treated_i \times Post_t) + \gamma Treated_i + \delta Post_t + \sum_{i=1}^{n} \theta_i X_i + \varepsilon_{it}$$

where:

Y_{it} represents the dependent variable, which reflects one of the result indicators (Chapter 5),

$Treated_i$ is a treatment dummy variable that indicates whether a sector/company is affected by the nEHS in combination with a carbon leakage compensation scheme (BECV) or not,

$Post_t$ is a time dummy variable that records whether the treatment (nEHS in combination with BECV) has already been introduced or not, and

$Treated_i \times Post_t$ is the interaction term of these two dummy variables.

β represents the **DiD estimator** that measures the average effect of the treatment on the treated units after the treatment ("Average Treatment Effect"),

X_i is a set of control variables, e.g. energy prices, which might have impacted the German energy-intensive industry in times of the energy crisis

θ_i, is the coefficient for the respective control variable X_i,

α is the constant,

γ is the general difference in level between the treated and non-treated units,

δ is the general trend over time, separated into before and after the treatment, and

ε_{it} represents the error term.

BECV effect

As already mentioned, the main challenge in evaluating the BECV compensation scheme is the difficulty of defining an appropriate control group. Given that the admission to the BECV compensation is regulated at the sector level and therefore any company in a sector with a carbon leakage risk is eligible for compensation, it is difficult to find a suitable control group for the BECV effect (companies/sectors that fall under the nEHS and belong to sectors eligible for compensation under the BECV, but ultimately do not receive compensation or companies/sectors in other countries with an nEHS but no carbon leakage compensation scheme similar to the BECV). In the following, we suggest three possible methods to estimate the BECV effect. All three methods for estimating the BECV effect are valid; however, the final

method choice highly depends on the data available for the evaluation in 2028. Table 5 in the appendix lists all manufacturing sectors grouped into the treatment and control group by method (Regression Discontinuity Design (RDD) and Difference-in-Difference (DiD)) for estimating the BECV effect.

Regression Discontinuity Design with CLIs based on EU-ETS Preliminary Carbon Leakage List

One method to assess the BECV effect is to apply **RDD**. RDD is an econometric method used to identify causal effects by exploiting a predetermined cutoff or threshold in the assignment of treatment. Units just above and below the cutoff are assumed to be similar, except for their treatment status, which allows for a comparison that approximates random assignment. By analysing the discontinuity around the threshold, researchers can estimate the local treatment effect with high internal validity. This method relies on the assumption that units cannot precisely manipulate the variable that determines the cutoff, ensuring that the assignment near the threshold is as good as random. RDD is commonly applied in evaluating policies, or other interventions based on specific criteria. The RDD method has several considerations. The estimated treatment effect is most accurate for individuals near the cutoff, which can limit its generalisability. It benefits from a large amount of data around the cutoff to ensure reliable estimates, which may sometimes be challenging to gather. The method assumes there are no other discontinuities around the cutoff that could influence the outcome, making it sensitive to specification errors. Additionally, selecting the appropriate bandwidth is crucial; a too-narrow bandwidth may reduce the sample size, while a too-wide bandwidth could include units less comparable to those near the cutoff point.

For an evaluation at the sector level, RDD with a threshold of 0.2, the relevant CLI threshold for the EU-ETS Preliminary Carbon Leakage List, could be applied to compare sectors that are just below the CLI threshold (control group) with sectors just above the CLI threshold (treatment group) and therefore eligible for the BECV compensation. For the RDD assumption to hold, sectors just below and just above the 0.2 CLI threshold should be similar in observable and unobservable characteristics, making their assignment to treatment as-if random. Given that the sectors around the 0.2 CLI threshold all operate in manufacturing and share comparable values for the CLI, we assume that the sectors are similar enough for the assumption to hold.[14] Yet, as the CLI is the product of emissions and trade intensity, the sectors cannot manipulate the variable that determines the cutoff of 0.2 (CLI). Therefore, sectors around the threshold of 0.2 (CLI) should be suitable for applying the RDD method. Applying this approach, the effect of the BECV is identifiable since the treatment group currently receives the BECV compensation, and a change in the BECV eligible sectors is unlikely in the near future, providing stability for analysis. However, the effect on whether carbon leakage is prevented might not be fully assessed in this setting, as some sectors in the treatment group are close to the cut-off or have a different CLI based on German data. This also represents a caveat of the method as the CLIs from the EU-ETS Preliminary Carbon Leakage List are based on EU-wide data rather than data specific to Germany.

Since selecting an appropriate bandwidth is critical for applying RDD, we analysed the number of observations across different bandwidths using the CLI for the manufacturing sectors according to the EU-ETS Preliminary Carbon Leakage List[15]. Figure 3 illustrates the CLI in all

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[14] However, sectors above the CLI threshold may vary widely, including those with high trade intensity but low emission intensity and those with high emission intensity but low trade intensity. Given the structural differences between trade-intensive and emissions-intensive sectors, this assumption of similarity represents a limitation of this approach and should be tested during implementation.

[15] https://climate.ec.europa.eu/system/files/2018-05/6_cll-ei-ti_results_en.pdf.

manufacturing sectors[16] (WZ 10-33). Figure 4 displays manufacturing sectors with a CLI < 0.4, including the respective bandwidths and the cut-off criterion of 0.2 described above. 24 sectors (2404 companies[17]) with a CLI between 0.1 and 0.2 (orange dots in Figure 4) are in the control group[18], while 8 sectors[19] (521 companies[20]) with a CLI between 0.2 and 0.3 (red dots in Figure 4) are in the treatment group. If the bandwidth is reduced to 0.15 to 0.2 and 0.2 to 0.25, the number of sectors (companies) in the control and treatment group falls to 9 (499) and 5 (397) respectively. While the sample size for the narrower bandwidths of 0.15 to 0.2 and 0.2 to 0.25 might be too small, we consider the sample size for the broader bandwidths of 0.1 to 0.2 and 0.2 to 0.3 to be sufficient for applying the RDD method. To ensure that results are not influenced by specific sector characteristics, dummy variables for each sector can be included in the estimation equation.

The RDD approach is preferably applied at the sector level based on the carbon leakage risk (CLI) of sectors as a cutoff criterion. As the CLI can only be determined at the sector level, it is not clear for an individual company if its CLI would lie above or below the cutoff criterion. Applying the RDD method at the company level is possible but requires the implementation of a Fuzzy RDD approach, an extension to the RDD used when the assignment to treatment is not perfectly determined by the cutoff. In a standard or "sharp" RDD, individuals on one side of the threshold always receive the treatment, while those on the other side do not. In a fuzzy RDD, there is imperfect compliance: some individuals on the "treatment" side do not receive the treatment, and some on the "control" side do. In case of the fuzzy RDD, the treatment group should be restricted to the companies that ultimately received the BECV compensation.

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[16] All manufacturing sectors except for sector 19.10 (Manufacture of coke oven products) with an EU CLI > 20.

[17] Sum of the number of companies in the respective sectors in 2022 (see Appendix for detailed information on the number of companies in each sector).

[18] A procedure for retroactive recognition (sector extension) is currently underway. Depending on the outcome, sectors currently part of the control group may be retroactively recognised and, as a result, should be excluded from the control group and added to the treatment group (affecting 1 sector at the 4-digit level and 4 subsectors at the 8-digit-level, which cannot be named for data protection reasons). If these subsectors are recognised, it is important to assess their significance within the sector and exclude the sector (4-digit level) from the control group if the subsectors are dominant within the sector.

[19] Sector 24.46 (Processing of nuclear fuel) is excluded, as there are no active companies in this sector in Germany according to DESTATIS Investitionserhebung (Investment survey in the manufacturing, mining and quarrying sector).
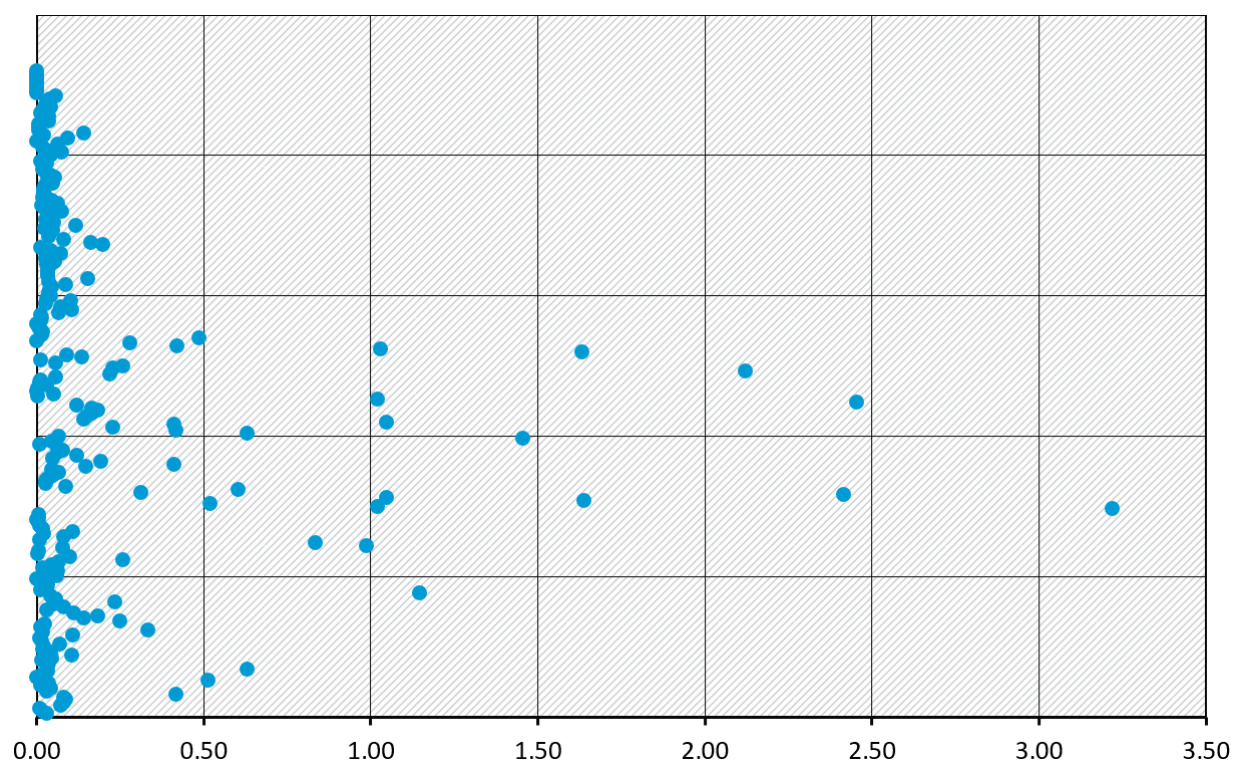
[20] The number is the sum of the number of companies in the respective sectors in 2022 (see Appendix for detailed information on the number of companies in each sector). This number does not equal the number of applicants for BECV compensation, which can be substantially lower.

Figure 3: **EU Carbon Leakage Indicators in Manufacturing – all Sectors**

Source: Own representation based on EU Carbon Leakage Indicators, Deloitte (2024).

Figure 4: **EU Carbon Leakage Indicators in Manufacturing – Sectors with CLI < 0.4**
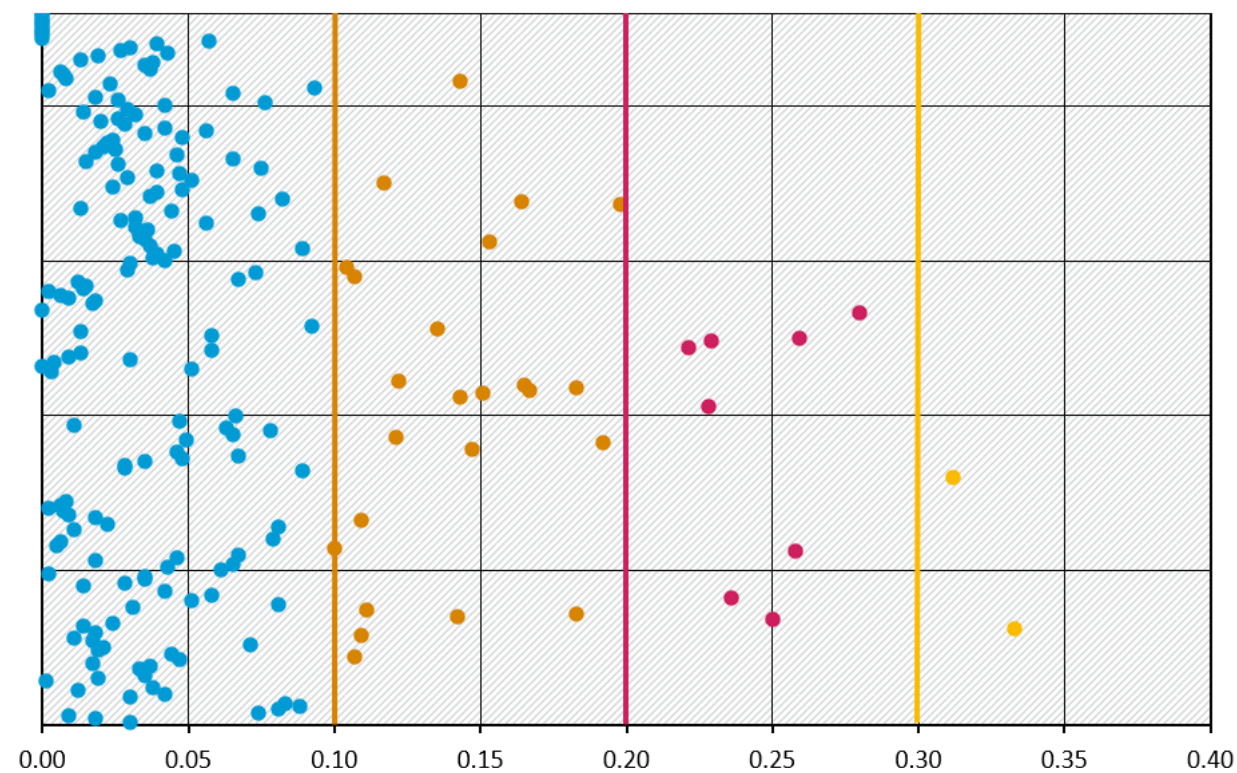
Source: Own representation based on EU Carbon Leakage Indicators, Deloitte (2024).

DiD with BECV sectors below the CLI threshold based on German data

Another approach is to take advantage of how the BECV sectors were initially selected: The CLI was not calculated based on the specific circumstances of German industry in the nEHS but rather used the results from the EU ETS carbon leakage assessment. However, the CLIs calculations based on EU data and German data vary in emissions and trade intensity. The discrepancy between the CLIs primarily arises from methodological differences. The EU CLI includes both direct and indirect (electricity-related) emissions and focuses solely on extra-EU trade. In contrast, the CLI based on German data considers only direct emissions and includes both extra- and intra-EU trade. Additionally, differences in industrial facilities and processes between Germany and other EU countries contribute to these variances. New calculations based on German data with updated emission and trade intensities (see separate report by Deloitte under the same commission, Evaluierung nach § 26 (3) BECV im Jahr 2024 im Auftrag des Umweltbundesamts) show that some sectors on the BECV list would have a CLI below 0.2. The method to determine the BECV effect in this context is to apply a **DiD** approach using BECV-eligible sectors listed on the BECV carbon leakage list[21] (sectors are identical to those on the EU-ETS Preliminary Carbon Leakage List with the exception of two sectors) but with a CLI below the 0.2 threshold, based on calculations with German data. In applying the DiD approach as described above, we leverage a unique classification feature of sectors listed BECV-eligible to estimate the causal effects of receiving the carbon leakage compensation. Specifically, we focus on eight sectors that are on the BECV carbon leakage list and have actually received the BECV compensation despite having a CLI below 0.2 according to CLI calculations based on German data. This selection of eight sectors in the treatment group presents a unique opportunity to assess the validity of the parallel trends assumption. These sectors do not qualify for carbon leakage compensation according to German Data, implying they share baseline characteristics with sectors not receiving compensation (control group). This similarity supports the parallel trends assumption, essential for DiD analyses, suggesting that any observed effects can be more confidently attributed to the compensation scheme rather than confounding factors. The sectors in the treatment and control groups should be similar in baseline characteristics, making their assignment to treatment effectively random. Hence, the assumption of comparability with the control group is valid, as German data indicates a lower carbon leakage risk. However, the effect on whether carbon leakage is prevented might not be perfectly assessed, since German data shows that the treatment sectors are not necessarily at high risk of carbon leakage.

The treatment group consists of eight sectors (487 companies[22]), which have received the BECV compensation but have a CLI below the threshold according to the calculations based on German data (CLI < 0.2). For the control group, we consider all non-treated sectors (companies) with a CLI < 0.2 up to the lowest CLI of the treatment group (0.02[23]), totalling 114 sectors (19,727 companies[24]). This ensures robust support down to the minimum CLI of 0.02, as seen in sector 24.51 (Casting of iron) of the treatment group. The DiD approach described can be applied at both the company and sector level. In case of the company level, the treatment group should be restricted to the companies that ultimately received the BECV compensation. To ensure that

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[21] To qualify for compensation under BECV, undertakings must be active in an eligible sector listed in the BECV Annex. These sectors mirror those in the Commission Delegated Decision (EU) 2019/708, identifying sectors at risk of carbon leakage for 2021-2030 (the "EU ETS Carbon Leakage List"), except for two sectors: NACE 14.11 (Manufacture of leather clothes) and NACE 07.29 (Mining of other non-ferrous metal ores). German authorities excluded these sectors as they do not have direct emissions from burning fuel but are included in the EU ETS List due to their indirect emissions from electricity consumption.

[22] The number is the sum of the number of companies in the respective sectors in 2022 (see Appendix for detailed information on the number of companies in each sector). This number does not equal the number of applicants for BECV compensation, which can be substantially lower.

[23] Exact value of the CLI (0.0159768) used for determination of the control group.

[24] Sum of the number of companies in the respective sectors in 2022.

results are not influenced by specific sector characteristics, like in the RDD approach, dummy variables for each sector can be included in the estimation equation.

Synthetic Control Methods (SCM)

 The SCM represents another approach to assess the BECV effect. SCM is another econometric technique used to evaluate the impact of an intervention or treatment when a suitable control group is not readily available. It constructs a synthetic control group by combining multiple untreated units to approximate the characteristics of the treated unit before the intervention. This method allows for a more accurate comparison by ensuring that the control group closely mirrors the pre-treatment characteristics of the treated group. The synthetic control method is particularly valuable in evaluating unique interventions or small-N studies where finding a comparable control group is challenging due to specific contextual factors or limited sample size.

By combining the SCM with entropy balancing, the causal inference can be enhanced as the comparability between the treated unit and the synthetic control group is improved. Entropy balancing is a statistical technique that reweights a dataset to match the covariate distribution of a treatment group with a control group. It is useful in observational studies without random assignment, ensuring balanced means, variances, and higher moments of covariates between groups to reduce bias in estimating treatment effects. Combining these methods leverages the strengths of both approaches, providing a more reliable counterfactual for causal inference. Without a thorough analysis, it is not possible to determine the size of the control and treatment groups for the SCM.

By constructing a synthetic control group that closely mirrors the treatment group, SCM provides a tailored approach that can be especially useful when traditional control groups are hard to establish. However, when panel data with both treated and control units before and after the intervention is available, DiD or RDD approaches can be just as effective. These methods directly compare changes in outcomes between treated and control groups over time, leveraging the assumption of parallel trends in the absence of treatment. Therefore, DiD or RDD might be preferred when sufficient panel data is accessible, with SCM serving as a valuable alternative when such data is not available.

Linkage to evaluation questions

The matched DiD method for the joint policy effect in combination with one of the three suggested methods for the BECV effect is applicable at the sector as well as company level and can be applied to measure the joint policy and BECV effect for the evaluation questions **D.1.1**[25], **D.1.2**[26], **D.2.1**[27], **D.2.2**[28] and **I.8**[29]. The same approach can be followed to answer evaluation question **D.4**[30]; however, the interaction term will be interacted with the company size or a regional dummy for East and West respectively. In case of evaluation question **A.15.2**[31], the same approach as for evaluation question **D.4** can be followed, however the interaction term will not be interacted with the company size or a regional dummy, but with the compensation level.

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[25] What impact does the BECV have on the reduction of Carbon Leakage?

[26] How and to what extent does the BECV impact competitiveness?

[27] Did the BECV lead to higher investments in energy efficiency and climate protection measures of companies in the sectors affected by the BECV compared to similar companies in sectors not affected by the BECV?

[28] What impact do investments in energy efficiency and climate protection measures under the BECV have on the emissions of the companies concerned?

[29] What impact does the BECV have on the trade activities of affected sectors?

[30] Have beneficiaries been affected differently by the BECV? Is there a difference in the effects regarding company size and location (East vs. West; small vs. large)?

[31] Does a higher compensation payment/higher compensation level lead to higher carbon leakage protection?

Alternative methods

Another quasi-experimental method available beyond the suggested methods is briefly discussed below.

Instrumental variables (IV) regression is an econometric technique used to address endogeneity issues, where an explanatory variable is correlated with the error term. It involves using an instrument, a variable that is correlated with the endogenous explanatory variable but uncorrelated with the error term, to provide consistent estimates of causal effects. IV regression is built on a two-stage approach: in the first stage, the endogenous variable is regressed on the instrument to isolate its exogenous variation; in the second stage, this predicted value is used to estimate the causal effect on the outcome variable. This method helps to eliminate bias from omitted variables, measurement errors, or simultaneous causality. However, finding a valid instrument that satisfies both relevance and exogeneity conditions can be challenging. A valid IV must be strongly correlated with the independent variable but must not be correlated with the dependent variable except through its effect on the independent variable. This stringent requirement makes the identification of appropriate instruments difficult, limiting the method's practical applicability in the context of BECV.

However, a form of an IV approach could be applied to evaluation question **D.2.2**[32]. In the first stage, the effect of the BECV (independent variable) on investments in energy efficiency and climate protection (dependent variable) is examined (see **D.2.1**[33]). In the second stage, the effect of these investments in energy efficiency and climate protection (independent variable), driven by BECV, on energy and emission intensity (dependent variable) is assessed. By applying this approach, only the effect of the investments due to BECV are captured and therefore separated from investments that cannot be explained with the introduction of BECV.

7.2   Quantitative methods

Besides econometric methods, other quantitative methods can prove beneficial in evaluations. These involve the systematic analysis of numerical data to assess program performance, outcomes, and impact. These include structured tools such as surveys, questionnaires, and administrative data to gather data that can be quantified and subjected to statistical analysis. Key quantitative techniques include descriptive statistics, which summarise data through measures such as means, medians, and standard deviations, and inferential statistics, allowing to draw conclusions and make predictions based on sample data.

Quantitative methods are particularly suited to answer the evaluation questions **I.9**[34], **A.14**[35] and **A.15.1**[36] on the indirect effects and cost-effectiveness of the BECV compensation payment. In order to qualitatively assess the impact of the BECV on downstream value chains in terms of employment and production (**I.9**), an Input-Output model can be applied. Descriptive statistics can be used to evaluate **A.14** by offering a clear picture of the total, average, and distribution of administrative costs. Moreover, the share of administrative costs in the overall budget can be calculated as a percentage. Additionally, a cost-benefit analysis (CBA) can be conducted to compare these administrative costs with the benefits (in monetary terms) provided by the BECV

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[32] What impact do investments in energy efficiency and climate protection measures under the BECV have on the emissions of the companies concerned?

[33] Did the BECV lead to higher investments in energy efficiency and climate protection measures of companies in the sectors affected by the BECV compared to similar companies in sectors not affected by the BECV?

[34] What impact does the BECV have on downstream value chains?

[35] What are the actual administrative costs and what share do they have in the overall budget of the BECV? (cost effectiveness)

[36] What effect does a higher carbon leakage risk (CLI) have on the compensation payment (level of compensation)?

program. This helps assessing the cost-effectiveness of the program's administration. To assess the impact of a higher carbon leakage risk (measured by CLI) on compensation payments under the BECV program (**A.15.1**), a descriptive analysis can be conducted using a scatterplot or other graphical methods to examine the relationship between the CLI of sectors and their corresponding compensation payments.

7.3   Qualitative and descriptive methods

Qualitative methods involve collecting non-numerical data through techniques like interviews, focus groups, and case studies to understand motivations, behaviours, and contextual factors influencing program outcomes. Descriptive methods, such as content analysis and thematic coding, organise and summarise qualitative data, providing structured frameworks for interpretations and to identify patterns. Qualitative and descriptive methods provide complementary approaches in evaluation, offering context to understand program impacts, stakeholder perspectives of program impacts, as well as the effectiveness of program design choices and in achieving policy objectives.

In the context of the BECV evaluation, qualitative and descriptive methods are most suitable for answering the evaluation questions **D.3**[37], **D.5**[38], **D.6**[39], **I.7**[40], **P.10**[41], **P.12**[42], **A.13**[43] and **A.16**[44]. Questions **D.3, I.7,** and **P.12** will be evaluated qualitatively based on the findings from **D.1**[45]. For questions **D.5, I.7, P.10, A.13,** and **A.16**, qualitative assessments may include interviews among other options. To assess **A.13** for example, qualitative methods like interviews can help to explore the perceptions of recipients on the BECV, particularly whether the operational programme implementation and the compensation scheme meet the requirements of the recipients. Interviews are conducted as part of the BECV consultation, which could be considered here. Subsequently, descriptive methods can be employed to categorise and summarise the insights into how stakeholders perceive the scheme's contributions and effectiveness in achieving its objectives.

7.4   Process-oriented analyses

Process-oriented analysis is a detailed examination of the activities, workflows, and procedures involved in an operation to ensure they are performed efficiently and effectively. This analysis begins with mapping out each step of the process, identifying the necessary inputs and expected outputs, and setting performance benchmarks to measure progress. Data collection is crucial, focusing on metrics such as time taken, resource utilisation, and error rates. By analysing this data, one can identify bottlenecks, inefficiencies, and areas needing improvement. The process is

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[37] How can the effects be classified and evaluated in an overall economic view?

[38] Has the aid significantly affected the behaviour of the beneficiaries? (Incentive effect)

[39] To what extent was the BECV responsible for the overall effects that have been achieved?

[40] Has the scheme contributed to the relevant policy objective? How do specific design choices of the BECV contribute to this? (Impact monitoring)

[41] Can potential BECV design changes improve results? (policy design)

[42] To what extent does the BECV contribute to carbon leakage protection in the future? (policy design)

[43] To what extent do the operational programme implementation and the compensation scheme meet the requirements of the aid recipients? (cost effectiveness)

[44] What is the benefit of the BECV in relation to other compensation schemes / carbon leakage protection schemes? (cost effectiveness)

[45] Whether and to what extent did the BECV achieve its objectives? (Target achievement)

then compared with best practices to highlight gaps and opportunities for optimisation and improvement.

In the context of the evaluation of the policy design, particularly the processes for implementing the BECV, a process-oriented analysis is best suited to answer evaluation question **P.11**[46]. Process-oriented analysis, when applied to evaluating the implementation of the BECV compensation scheme, involves a review of the procedural steps and operational workflows involved in administering compensation to eligible sectors. This analysis begins by mapping out the specific processes for determining eligibility, application submission, assessment criteria, and disbursement of funds. It focuses on identifying inputs such as application documents and financial data, and outputs including the amount of compensation awarded and the timeliness of disbursement.

Performance benchmarks are set to measure the efficiency and effectiveness of each process step. Data collection includes tracking the time taken for each process, assessing the accuracy of eligibility determinations, and evaluating stakeholder satisfaction through feedback mechanisms. By comparing these processes with best practices in state aid administration, potential bottlenecks or procedural inefficiencies can be pinpointed and recommendations for improvement derived.

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[46] Are the processes for implementing the programme on target? (policy design)

8   Data collection and data sources

As a concluding step, this chapter summarises data collection and respective sources for the evaluation, particularly to address the evaluation questions.

We recommend utilising company- and sector-level data from various sources, including regulatory data, to apply the methods (Chapter 7) and assess the indicators. The data sources for the indicators used to assess the evaluation questions are detailed in Chapter 5. To ensure cost-effectiveness and minimise the administrative burden, data for the BECV evaluation primarily relies on public databases for sector-level information and regulatory data compiled by the German Emissions Trading Authority (DEHSt). Company-level data, on the other hand, requires paid access, for example to company databases such as AFiD (Administrative Company Panel Data) or ORBIS. In the following, we evaluate data based on relevance to the research design (DiD, RDD and SCM), evaluation questions, and outcome indicators. Additionally, we assess data quality, frequency of publication, accessibility, dataset integration (matching), and any identifiable limitations. In general, the result indicators can be evaluated at both sector and company levels, except for certain competition indicators (HHI; Lerner Index) that require company-level data on market shares, number of companies, profits, and costs. While we anticipate potential improvements in the data landscape by 2028, the subsequent assessment of data sources is limited to currently available data sources.

Sector-level data

The data sources assessed in the following can be used for the BECV evaluation at the sector level. First, the data sources for German manufacturing sectors to estimate the joint policy and BECV effects are discussed. Data sources for other European manufacturing sectors, serving as the control group for estimating the joint policy effect, are assessed subsequently. Destatis, the Federal Statistical Office of Germany, provides comprehensive datasets on energy usage, environmental protection, investments, cost structures, production and trade of manufacturing sectors in Germany. Data collection methods involve extensive surveys and the obligation to provide information ensures a high response rate, thereby increasing the accuracy of the results. The release frequency varies, with some indicators updated monthly, others quarterly or annually. Destatis offers data at the sector level (NACE classification) and other levels of detail, including national and regional levels. The data is publicly accessible through their comprehensive online portal. For identifying the joint policy effect (treatment group) and BECV effect at the sector level, sector-level data of German manufacturing sectors is required. The relevant Destatis data sets for that purpose in the context of the BECV evaluation are outlined in Table 2.

Table 2:   **Data Sources – Sector level – Germany**

Data Source	Relevant Variables	Data Collection Frequency	Data Release Frequency	Industry Classification
Destatis Energieverwendung im Verarbeitenden Gewerbe (43531)	Energy (fuel) consumption for the calculation of emissions and	Annual	End of the following year after the reporting year[47]	NACE (2 digits) NACE (4 digits) on request

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[47] Qualitätsbericht - Jahreserhebung über die Energieverwendung der Betriebe im Verarbeitenden Gewerbe sowie im Bergbau und in der Gewinnung von Steinen und Erden - 2023 (destatis.de).

Data Source	Relevant Variables	Data Collection Frequency	Data Release Frequency	Industry Classification
	emission intensity			
Destatis **Investitionserhebung (42231)**	Revenue, employees, investments, tangible assets (fixed assets), number of companies	Annual	12 months after the end of the reporting year[48]	NACE (4 digits)
Destatis **Kostenstrukturerhebung (42251)**	Revenues, employees, gross value added	Annual	18 months after the end of the reporting year[49]	NACE (4 digits)
Destatis **Produktionserhebung (42131)**	Production value	Monthly, quarterly and annual	Monthly: 38 days after the end of the reporting month, Quarterly: 3 months after the end of the reporting quarter, Annually: 4 months after the end of the reporting year[50]	NACE (goods index) (4 digits)
Destatis **Aus- und Einfuhr (Außenhandel) (51000)**	Imports (EU/non-EU), exports (EU/non-EU)	Monthly	40 days after the end of a reporting month[51]	NACE (goods index) (4 digits)
Destatis **Erhebung der Investitionen für den Umweltschutz (32511)**	Investments in climate protection and energy efficiency	Annual	18 months after the end of the reporting year[52]	NACE (2 digits)
Destatis **Laufende Aufwendungen für den Umweltschutz im Produzierenden Gewerbe (32521)**	Expenses for environmental protection	Annual	18 months after the end of the reporting year[53]	NACE (2 digits)
Price for emission certificates (Paragraph 10 BEHG)	Emission costs	N/A	N/A	N/A

Source: Own illustration, Deloitte (2024).

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[48] Qualitätsbericht - Investitionserhebung im Bereich Verarbeitendes Gewerbe, Bergbau und Gewinnung von Steinen und Erden - 2021 (destatis.de).

[49] Qualitätsbericht Kostenstrukturerhebung im Verarbeitenden Gewerbe (destatis.de).

[50] Qualitätsbericht - Produktionserhebungen im Verarbeitenden Gewerbe sowie des Bergbaus und der Gewinnung von Steinen und Erden - 2023 (destatis.de).

[51] Qualitätsbericht - Außenhandel 2023 (destatis.de).

[52] Investitionen für den Umweltschutz im Produzierenden Gewerbe - Qualitätsbericht - 2020 (destatis.de).

[53] Qualitätsbericht - Erhebung der laufenden Aufwendungen für den Umweltschutz (destatis.de).

Second, to apply the matched DiD approach and identify the joint policy effect of the nEHS with the BECV for the European control group, sector-level data on result indicators across European countries is required. Eurostat, and specifically the Eurostat Structural Business Statistics (SBS), offers comprehensive data on the structure and performance of businesses within the EU. SBS covers the non-financial business economy, including manufacturing sectors. Data is collected annually from national statistical institutes and is available at different levels of detail, including by sector (NACE Rev. 2 classification), size class of enterprises, and regions (NUTS classification). Typically, initial SBS data are released one year after the conclusion of the reference year, with final data becoming available two years thereafter. The rigorous data collection methods and adherence to quality standards ensure high data quality and accuracy, making it reliable for evaluation purposes. The data is publicly accessible, providing a valuable resource for analysing sectors across all EU member states. Table 3 provides a review of the relevant data sets for assessing the evaluation questions, particularly the joint policy effect.

Table 3:   **Data Sources – Sector level – Europe**

Data Source	Relevant Variables	Data Collection Frequency	Data Release Frequency	Industry Classification	Remarks
Eurostat Energy statistics	Energy consumption for the calculation of emissions and emission intensity	Monthly and annual	Annual energy statistics by 31 January in the second year after the reporting year (Y+2)[54]	NACE (2 digits)	Limited availability of energy data at sector level (mainly at country level)
Eurostat (SBS) Annual detailed enterprise statistics for industry	Production value, Value added, Revenues (turnover), employees, tangible fixed assets, profits, total factor productivity, number of companies	Annual	Data submitted to Eurostat 18 months after reference period, published shortly thereafter[55]	NACE (4 digits)	
Eurostat Environmental protection expenditure	Investments in climate protection (pollution control equipment, cleaner technology)	Annual	Data submitted to Eurostat 18 months after reference period, published shortly thereafter[56]	NACE (2 digits)	Limited data availability at sector level (2 digits), data only for some manufacturing sectors available
Eurostat Balance of	Foreign direct investment (FDI)	Annual	Around 12 months after	NACE (2 digits)	Limited data availability at

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[54] Energy statistics - quantities (nrg_quant) (europa.eu).

[55] Structural business statistics - historical data (sbs_h) (europa.eu).

[56] Structural business statistics - historical data (sbs_h) (europa.eu).

Data Source	Relevant Variables	Data Collection Frequency	Data Release Frequency	Industry Classification	Remarks
payments - International transactions (EU direct investment positions, by country and economic activity)			reference period (all data are compiled annually, so the reference period is typically a calendar year)[57]		sector level (2 digits), data only for some manufacturing sectors available
Eurostat Community innovation survey 2020	Product innovation, business process innovation, innovation (R&D) activities/expenditures	Every two years	Final data in the second semester of even-numbered years (t+2)[58]	NACE (2 digits)	Limited data availability at sector level (2 digits), data only for some manufacturing sectors available
Eurostat International Trade in goods	Imports, exports, trade surplus	Annual	Data submitted to Eurostat within 12 months of reference year, published shortly thereafter[59]	NACE (2 digits)	Limited data availability at sector level (2 digits), data only for some manufacturing sectors available

Source: Own illustration, Deloitte (2024).

Both SBS and Destatis data can be integrated into other datasets, facilitated by standardised classifications, such as the NACE classification, which ensure seamless integration with both national and international datasets. While sector-level data are widely available, there are limitations in terms of data granularity. Variables related to energy consumption, innovation, environmental protection, FDIs, and trade in both Destatis and Eurostat are restricted to the 2-digit NACE level which constrains the application of econometric methods at the 4-digit level. Disaggregating these variables to the 4-digit level, using metrics such as revenues, could potentially mitigate this issue, although it may dilute the precision and significance of the results. Overall, sufficient data appears to be accessible for both Germany and other EU countries to apply the DiD approach for assessing the joint policy effect and DiD, RDD or SCM for evaluating the BECV effect at the sector-level.

Company-level data

The Administrative Company Panel Data (Amtliche Firmendaten für Deutschland - AFiD) provides a comprehensive database to assess the BECV effect at the company-level. Managed by

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[57] European Union direct investments (bop_fdi) (europa.eu).

[58] Community innovation survey 2020 (CIS2020) (inn_cis12) (europa.eu).

[59] International trade in goods - trade by enterprise characteristics (TEC) (ext_tec) (europa.eu).

the German Federal Statistical Office, this database offers a range of critical company statistics, including modules on environmental protection investments, energy utilisation, and trade within the manufacturing industry across Germany. Data is available at the regional (state) level, with companies categorised by their respective sectors, using the NACE classification. The survey is conducted annually and mandated by German law. Foreign trade statistics are collected and published monthly. All other surveys are conducted annually. Access typically involves an application process to uphold data responsibility. AFiD assigns unique identification numbers to each company (company and business number), facilitating linkage with other AFiD datasets. Hence, AFiD modules and panels can be seamlessly integrated using legal entity identifiers, typically the company number. However, AFiD data is exclusively released in anonymised format, where the original direct identifier "company number" is transformed into a system-generated company ID for evaluation purposes. This anonymisation prevents direct integration in other external datasets, as AFiD lacks a unique identifier that aligns with those used in external datasets. For applying the econometric methods, this means it is not possible to ascertain whether the company actually received carbon leakage compensation; it only indicates whether the company is in a sector that is eligible for the BECV compensation. Table 4 summarises the relevant AFiD data sets for the BECV evaluation at the company level.

Table 4:   Data Sources – Company level – Germany

Data Source	Relevant Variables	Data Collection Frequency	Data Release Frequency	Company Identifier
AFiD- Modul: Energieverwendung	Energy consumption for the calculation of emissions and emission intensity	Annual	12 months after reporting year[60]	Company ID
AFiD-Modul: Umweltschutzinvestitionen	Environmental protection investments	Annual	18 months after reporting year[61]	Company ID
AFiD-Panel Industrieunternehmen (Kostenstrukturerhebung und Investitionserhebung)	Tangible fixed assets, revenues, production value, value added, employees, profits, costs, number of companies, investments in immaterial assets (patents)	Annual	12 months after reporting year[62]	Company ID
AFiD-Panel Außenhandelsstatistik	Imports, exports	Monthly	Monthly, 40 days after reporting month[63]	Company ID

Source: Own illustration, Deloitte (2024).

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[60] afid-panel_industriebetriebe_1995-2021_mdr_teil2_produkt.pdf (forschungsdatenzentrum.de).

[61] afid-modul_umweltschutzinvestitionen_2018_mdr_teil1_statistik_final.pdf (forschungsdatenzentrum.de).

[62] afid-panel_industriebetriebe_1995-2021_mdr_teil2_produkt.pdf (forschungsdatenzentrum.de).

[63] AHS_MDR-Produkt_2011-2020_On-Site.pdf (forschungsdatenzentrum.de).

In addition, if the effort is manageable and the added value is high, data at the company-level from the German company register can be added manually.

For studying the joint policy effect with a European control group at the company-level, commercial company data sources such as Orbis can be considered. Orbis maintains data on over 375 million companies around the globe and offers company information covering areas such as financials, ownership, and management structures. The datasets result largely from blending publicly available records with direct company interactions. While they deliver broad coverage, they do not provide the same accuracy assurance as those from governmental sources. In commercial databases like Orbis, each company has a unique identifier in addition to usual identifiers such as business registration numbers. Access to the commercial databases like Orbis requires a paid subscription, with costs varying based on the level of access needed. Regarding the result indicators relevant for this evaluation, Orbis only provides financial data such as revenue, tangible fixed assets, investments, profit figures, and employee numbers. Hence, one of the main drawbacks of ORBIS is its lack of specific variables related to energy usage and climate protection; instead, it primarily focuses on financial metrics. In order to obtain more accurate company-level data for other European countries (EU control group for joint policy effect), data provided by national company registers or respective national statistics offices, which offer company panel data like AFiD, should be considered. In addition, environmental information such as emissions under the CSRD[64] (Corporate Sustainability Reporting Directive) could be another valuable source for assessing the joint policy effect. The CSRD, introduced in January 2023, mandates companies to disclose information on their environmental and social impacts.

Overall, although there are some data gaps at the company level for certain performance indicators (e.g., innovation indicators) the general data availability at the company level, particularly for Germany, should be sufficient for the application of DiD, RDD or SCM to estimate the BECV effect.

Regulatory data

BECV regulatory data (e.g., BECV compensation allocated, BECV budget, BECV administrative costs, investments of beneficiaries in climate protection and energy efficiency, total funding volume, total auction volume of Germany's nEHS) is compiled by the German Emissions Trading Authority (DEHSt). Regulatory data is particularly relevant for assessing the cost-effectiveness of the BECV and its impact on climate protection and energy efficiency investments, as DEHSt collects this data as part of the BECV allocation process. The first batch of BECV regulatory data became available by the end of 2023. Since the regulatory BECV data is not published at a fixed time, it is not possible to make precise statements about future data releases. However, as with most data sources, we assume that BECV regulatory data is reported with a time lag of about one year. It should be evaluated to what extent the BECV regulatory data can be made accessible to evaluators for conducting the BECV evaluation. Depending on data protection and confidentiality requirements, regulatory data will likely only be available at the sector level and not at the company level. Sector-level regulatory data can then be matched with other datasets based on NACE codes (2- or 4-digits).

Overall, after reviewing the sector, company, and regulatory data relevant for the BECV evaluation, restricted data availability and confidentiality obligations, especially at the company level, indicate focusing on the sector level when applying the methods to answer the evaluation questions.

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[64] Directive (EU) 2022/2464 Corporate Sustainability Reporting.

9   Evaluation procedure

This chapter outlines the general evaluation procedure.

The empirical evaluation laid out in this evaluation plan will be integrated into the already existing three evaluation procedures described in paragraph 26 BECV.

1. According to paragraph 26 (1) BECV the competent authority (Umweltbundesamt – UBA) shall evaluate the compensation procedures carried out for the previous accounting year and publish a report on the main results.
2. Paragraph 26 (2) BECV defines that from 2022 onwards, the competent authority will annually consult interest groups active for affected sectors or subsectors, social partners, and experts in the field of carbon leakage protection. The consultation shall assess the competitive situation of companies in Germany, in particular with regard to small and medium-sized enterprises. To this end, the Federal Government shall submit a report to the German Bundestag by September 30 of each year.
3. According to paragraph 26 (3) BECV, after completion of the compensation procedure for the accounting year 2022, BMWK shall also commission an external body to evaluate the implementation of the BECV. The evaluation shall include a process analysis and a structural analysis of whether and to what extent the subsequent increase in the price in the nEHS leads to job displacements in the individual sectors as well as a review of the need for further development of the compensation system. According to paragraph 26 (3) BECV, one focus of this evaluation shall be:
    i.   if the carbon leakage indicators for the quantitative and qualitative assessment pursuant to paragraphs 20 and 21 BECV shall be revised,
    ii. if an increase of the compensation levels is necessary,
    iii. if the introduction of a national correction factor is necessary
    iv. if an intra-year disbursement of the aid is necessary.

    The evaluation defined in paragraph 26 (3) BECV shall be carried out until September 30, 2024 and then every four years.

4. Lastly, paragraph 26 (4) BECV defines that based on the reports pursuant to paragraph 26 (1) and (2) BECV and the evaluation pursuant to (3) BECV, the Federal Government shall regularly review whether there is a need for amendments to the BECV.

BMWK will assess the selected proposal, including the final research design, based on the call for proposals. In cooperation with the external evaluation contractors, the BMWK will determine the best way to integrate the evaluation into the existing evaluation processes in accordance with this evaluation plan. Given the time frame and content, the evaluation defined in paragraph 26 (3) BECV works as a suitable framework for this.

If the final research design applies an ex-post evaluation using econometric techniques, this will require at least three years of ex-post data. In line with the BECV's entering into effect in July 2021 and its subsequent notification by the Commission in August 2023, years for the post-treatment period would need to be at least 2023, 2024 and 2025. Given that we expect most data to be reported with a one-year time lag, the data would be available by the end of 2026 or the beginning of 2027. If this is the case, the econometric analysis could thus start at the earliest at the beginning of 2027. If an alternative approach is needed, e.g. based more on descriptive analysis, an earlier data might be possible.

The second report for paragraph 26 (3) BECV, to be carried out until September 30, 2028, could thus provide a good framework to integrate the evaluation report in accordance with this

evaluation plan, as described in section 2. In this case, BMWK will assess if the evaluation report could then become part of the 4-year evaluation period of paragraph 26 (3) BECV.

As suggested within the evaluation plan, the first report for paragraph 26 (3) BECV, to be carried out until September 30, 2024, has been used to integrate this progress report that explains the research design, empirical questions and result indicators for the evaluation report that has to be delivered to the European Commission in 2028.

In that regard, the evaluation report will be also subject to paragraph 26 (4) BECV that obliges the Federal Government based on the evaluation processes to regularly assess whether there is a need for amendments to the BECV.

BMWK will ensure that the evaluation will be objective and precise as well as impartial and transparent. An independent body that still has to be selected will carry out the evaluation in accordance with the evaluation plan, using this progress report as its fundamental basis. BMWK will put the selection of the evaluation body out to public tender. Criteria to select the evaluators will be independence, experience and the economic and methodological expertise necessary to conduct a comprehensive and reliable evaluation.

10 Timeframe

In the following chapter the time frame for the evaluation for the European Commission is briefly described.

The BECV entered into force on July 28, 2021, pursuant to paragraph 28 of the BECV. Still being subject to the reservation of approval by the European Commission under state aid law provided for in paragraph 27 of the BECV at the time, the BECV was formally notified by the Commission on August 10, 2023 and, hence, fully applied since then. In accordance with paragraph 13 (1) BECV, applications for the accounting year 2021 had to be submitted to the competent authority (DEHSt) by June 30, 2022.

BECV regulatory data regarding the accounting year 2021, as compiled by DEHSt, was made available in early 2024. If the final research design applies an ex-post evaluation using - econometric techniques, BMWK expects the analysis to start at the earliest at the beginning of 2027 (see Chapter 9).

The selection of the evaluation body for compiling the progress report was put out to public tender in 2023. By decree, the BMWK has assigned said process as well as its subsequent supervision during the project's duration to DEHSt. After completion of the tender, the evaluation body has filed this progress report at hand in 2024. The evaluation in 2028 will be subject to a separate public tender at a later point in time.

BMWK will assess the selected proposal, including the final research design, based on the call for proposals. In cooperation with external evaluation contractors, the BMWK will determine the best way to integrate the evaluation into the existing evaluation processes in accordance with this evaluation plan.

11 Publication

This chapter presents the plans of the competent authority to publish the results of the evaluation in accordance with the evaluation plan.

The DEHSt will publish each of the reports described in chapter 9 on its website. The published results of the evaluation in accordance with the evaluation plan as submitted to the European Commission will comply with provisions of the German statistical law and statistical secrecy.

Access to third-party data will be subject to the rules imposed by these third-party bodies. Personal and/or confidential data will be used in accordance with the relevant regulations. For the purpose of replication and further studies, evaluation material (e.g. data, code) will be made available, whenever possible, in accordance with relevant regulations and deemed adequate.

CLIMATE CHANGE 'National Ordinance on Measures to Avoid Carbon Leakage **in** the National Fuel Emissions Trading System' (BEHG Carbon Leakage Ordinance, BECV) – Evaluation Progress Report

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A   Appendix

Table 5:   Sectors in the treatment (1) and control (0) group by method for estimating the BECV effect

Sector	Description	No. of companies[65]	DiD[66]	RDD[67]
10.11	Processing and preserving of meat	229	0	
10.12	Processing and preserving of poultry meat	47	0	
10.13	Production of meat and poultry meat products	1077	0	
10.20	Processing and preserving of fish, crustaceans and molluscs	44	0	
10.31	Processing and preserving of potatoes	30		
10.32	Manufacture of fruit and vegetable juice	60	0	
10.39	Other processing and preserving of fruit and vegetables	118	0	
10.41	Manufacture of oils and fats	28		
10.42	Manufacture of margarine and similar edible fats	6	0	
10.51	Operation of dairies and cheese making	151	0	
10.52	Manufacture of ice cream	13	0	
10.61	Manufacture of grain mill products	81	0	
10.62	Manufacture of starches and starch products	14		
10.71	Manufacture of bread; manufacture of fresh pastry goods and cakes	2293		
10.72	Manufacture of rusks and biscuits; manufacture of preserved pastry goods and cakes	72	0	
10.73	Manufacture of macaroni, noodles, couscous and similar farinaceous products	18	0	
10.81	Manufacture of sugar	5		
10.82	Manufacture of cocoa, chocolate and sugar confectionery	138	0	
10.83	Processing of tea and coffee	61		
10.84	Manufacture of condiments and seasonings	66	0	
10.85	Manufacture of prepared meals and dishes	62	0	

[65] Number of companies in the respective sectors in 2022 according to Destatis Investitionserhebung (42231).

[66] CLI based on BECV Carbon Leakage list (identical to sectors in EU-ETS Preliminary Carbon Leakage List except for two sectors) and CLI calculations using German Data (see Evaluierung nach § 26 (3) BECV im Jahr 2024 im Auftrag des Umweltbundesamts).

[67] CLI based on EU-ETS Preliminary Carbon Leakage List (lower bandwidth with CLI 0.1–0.2 as the control group; upper bandwidth with CLI 0.2–0.3 as the treatment group).

Sector	Description	No. of companies[65]	DiD[66]	RDD[67]
10.86	Manufacture of homogenised food preparations and dietetic food	14	0	0
10.89	Manufacture of other food products n.e.c.	145	0	
10.91	Manufacture of prepared feeds for farm animals	117	0	
10.92	Manufacture of prepared pet foods	68	0	
11.01	Distilling, rectifying and blending of spirits	48		
11.02	Manufacture of wine from grape	32		
11.03	Manufacture of cider and other fruit wines	4	0	
11.04	Manufacture of other non-distilled fermented beverages	1	0	0
11.05	Manufacture of beer	240	0	
11.06	Manufacture of malt	14		
11.07	Manufacture of soft drinks; production of mineral waters and other bottled waters	133	0	
12.00	Manufacture of tobacco products	18		
13.10	Preparation and spinning of textile fibres	31	1	1
13.20	Weaving of textiles	79	0	0
13.30	Finishing of textiles	81		0
13.91	Manufacture of knitted and crocheted fabrics	34	0	0
13.92	Manufacture of made-up textile articles, except apparel	163	0	
13.93	Manufacture of carpets and rugs	19	0	
13.94	Manufacture of cordage, rope, twine and netting	19	0	
13.95	Manufacture of non-wovens and articles made from non-wovens, except apparel	47	1	1
13.96	Manufacture of other technical and industrial textiles	123	0	
13.99	Manufacture of other textiles n.e.c.	31	0	
14.11	Manufacture of leather clothes	2		
14.12	Manufacture of workwear	26		
14.13	Manufacture of other outerwear	61	0	
14.14	Manufacture of underwear	29	0	
14.19	Manufacture of other wearing apparel and accessories	39	0	
14.20	Manufacture of articles of fur	1	0	

Sector	Description	No. of companies[65]	DiD[66]	RDD[67]
14.31	Manufacture of knitted and crocheted hosiery	14	0	
14.39	Manufacture of other knitted and crocheted apparel	11	0	
15.11	Tanning and dressing of leather; dressing and dyeing of fur	13		
15.12	Manufacture of luggage, handbags and the like, saddlery and harness	33	0	
15.20	Manufacture of footwear	55	0	
16.10	Sawmilling and planing of wood	234	0	
16.21	Manufacture of veneer sheets and wood-based panels	75	1	1
16.22	Manufacture of assembled parquet floors	6	0	0
16.23	Manufacture of other builders' carpentry and joinery	465		
16.24	Manufacture of wooden containers	160	0	
16.29	Manufacture of other products of wood; manufacture of articles of cork, straw and plaiting materials	80	0	
17.11	Manufacture of pulp	11		
17.12	Manufacture of paper and paperboard	136		
17.21	Manufacture of corrugated paper and paperboard and of containers of paper and paperboard	350	0	
17.22	Manufacture of household and sanitary goods and of toilet requisites	42		
17.23	Manufacture of paper stationery	41		
17.24	Manufacture of wallpaper	7	0	0
17.29	Manufacture of other articles of paper and paperboard	141	0	
18.11	Printing of newspapers	45		
18.12	Other printing	735		
18.13	Pre-press and pre-media services	134		
18.14	Binding and related services	79		
18.20	Reproduction of recorded media	8		
19.10	Manufacture of coke oven products	1	0	
19.20	Manufacture of refined petroleum products	49	0	
20.11	Manufacture of industrial gases	10		
20.12	Manufacture of dyes and pigments	49		

Sector	Description	No. of companies[65]	DiD[66]	RDD[67]
20.13	Manufacture of other inorganic basic chemicals	72		
20.14	Manufacture of other organic basic chemicals	114		
20.15	Manufacture of fertilisers and nitrogen compounds	21		
20.16	Manufacture of plastics in primary forms	170		
20.17	Manufacture of synthetic rubber in primary forms	7		
20.20	Manufacture of pesticides and other agrochemical products	32		
20.30	Manufacture of paints, varnishes and similar coatings, printing ink and mastics	186	0	
20.41	Manufacture of soap and detergents, cleaning and polishing preparations	116	0	
20.42	Manufacture of perfumes and toilet preparations	122	0	
20.51	Manufacture of explosives	13	0	
20.52	Manufacture of glues	34	0	
20.53	Manufacture of essential oils	20	0	
20.59	Manufacture of other chemical products n.e.c.	287	0	0
20.60	Manufacture of man-made fibres	26		
21.10	Manufacture of basic pharmaceutical products	40		0
21.20	Manufacture of pharmaceutical preparations	237	0	
22.11	Manufacture of rubber tyres and tubes; retreading and rebuilding of rubber tyres	18	0	0
22.19	Manufacture of other rubber products	240	0	
22.21	Manufacture of plastic plates, sheets, tubes and profiles	481	0	
22.22	Manufacture of plastic packing goods	341	0	
22.23	Manufacture of builders' ware of plastic	481	0	
22.29	Manufacture of other plastic products	1304	0	
23.11	Manufacture of flat glass	10		
23.12	Shaping and processing of flat glass	174	0	
23.13	Manufacture of hollow glass	40		
23.14	Manufacture of glass fibres	27		
23.19	Manufacture and processing of other glass, including technical glassware	69		1

Sector	Description	No. of companies[65]	DiD[66]	RDD[67]
23.20	Manufacture of refractory products	42		
23.31	Manufacture of ceramic tiles and flags	19		
23.32	Manufacture of bricks, tiles and construction products, in baked clay	63		0
23.41	Manufacture of ceramic household and ornamental articles	23		0
23.42	Manufacture of ceramic sanitary fixtures	6		0
23.43	Manufacture of ceramic insulators and insulating fittings	9		0
23.44	Manufacture of other technical ceramic products	31	0	0
23.49	Manufacture of other ceramic products	15	0	0
23.51	Manufacture of cement	23		
23.52	Manufacture of lime and plaster	18		
23.61	Manufacture of concrete products for construction purposes	431	0	
23.62	Manufacture of plaster products for construction purposes	7		
23.63	Manufacture of ready-mixed concrete	177		
23.64	Manufacture of mortars	33	0	
23.65	Manufacture of fibre cement	11	0	
23.69	Manufacture of other articles of concrete, plaster and cement	12	0	
23.70	Cutting, shaping and finishing of stone	84		
23.91	Production of abrasive products	35	0	
23.99	Manufacture of other non-metallic mineral products n.e.c.	128		1
24.10	Manufacture of basic iron and steel and of ferro-alloys	71		
24.20	Manufacture of tubes, pipes, hollow profiles and related fittings, of steel	122	1	1
24.31	Cold drawing of bars	21	1	1
24.32	Cold rolling of narrow strip	30		
24.33	Cold forming or folding	57		
24.34	Cold drawing of wire	40	0	0
24.41	Precious metals production	13	0	
24.42	Aluminium production	78		
24.43	Lead, zinc and tin production	19		

Sector	Description	No. of companies[65]	DiD[66]	RDD[67]
24.44	Copper production	44	1	
24.45	Other non-ferrous metal production	28	1	1
24.46	Processing of nuclear fuel	-		
24.51	Casting of iron	119	1	
24.52	Casting of steel	32		
24.53	Casting of light metals	157	0	
24.54	Casting of other non-ferrous metals	37	0	
25.11	Manufacture of metal structures and parts of structures	1343		
25.12	Manufacture of doors and windows of metal	381		
25.21	Manufacture of central heating radiators and boilers	21	0	
25.29	Manufacture of other tanks, reservoirs and containers of metal	138		
25.30	Manufacture of steam generators, except central heating hot water boilers	24		
25.40	Manufacture of weapons and ammunition	26		
25.50	Forging, pressing, stampingand roll-forming of metal; powder metallurgy	886	0	0
25.61	Treatment and coating of metals	846	0	
25.62	Machining	1807	0	
25.71	Manufacture of cutlery	32	0	0
25.72	Manufacture of locks and hinges	166	0	
25.73	Manufacture of tools	728	0	
25.91	Manufacture of steel drums and similar containers	37	0	
25.92	Manufacture of light metal packaging	42	0	
25.93	Manufacture of wire products, chain and springs	228	0	
25.94	Manufacture of fasteners and screw machine products	154	0	
25.99	Manufacture of other fabricated metal products n.e.c.	457	0	
26.11	Manufacture of electronic components	246	0	0
26.12	Manufacture of loaded electronic boards	89		
26.20	Manufacture of computers and peripheral equipment	110	0	
26.30	Manufacture of communication equipment	122		

Sector	Description	No. of companies[65]	DiD[66]	RDD[67]
26.40	Manufacture of consumer electronics	57		
26.51	Manufacture of instruments and appliances for measuring, testing and navigation	874	0	
26.52	Manufacture of watches and clocks	29	0	
26.60	Manufacture of irradiation, electromedical and electrotherapeutic equipment	44		
26.70	Manufacture of optical instruments and photographic equipment	183		
26.80	Manufacture of magnetic and optical media	3		
27.11	Manufacture of electric motors, generators and transformers	270	0	
27.12	Manufacture of electricity distribution and control apparatus	617		
27.20	Manufacture of batteries and accumulators	47	0	0
27.31	Manufacture of fibre optic cables	16	0	0
27.32	Manufacture of other electronic and electric wires and cables	130	0	
27.33	Manufacture of wiring devices	166		
27.40	Manufacture of electric lighting equipment	173	0	
27.51	Manufacture of electric domestic appliances	78		
27.52	Manufacture of non-electric domestic appliances	30		
27.90	Manufacture of other electrical equipment	414		0
28.11	Manufacture of engines and turbines, except aircraft, vehicle and cycle engines	91		
28.12	Manufacture of fluid power equipment	135		
28.13	Manufacture of other pumps and compressors	175	0	
28.14	Manufacture of other taps and valves	232	0	
28.15	Manufacture of bearings, gears, gearing and driving elements	319	0	
28.21	Manufacture of ovens, furnaces and furnace burners	114		
28.22	Manufacture of lifting and handling equipment	522		
28.23	Manufacture of office machinery and equipment (except computers and peripheral equipment)	23	0	
28.24	Manufacture of power-driven hand tools	30		
28.25	Manufacture of non-domestic cooling and ventilation equipment	359		

Sector	Description	No. of companies[65]	DiD[66]	RDD[67]
28.29	Manufacture of other general-purpose machinery n.e.c.	709		
28.30	Manufacture of agricultural and forestry machinery	169	0	
28.41	Manufacture of metal forming machinery	438		
28.49	Manufacture of other machine tools	217		
28.91	Manufacture of machinery for metallurgy	32		
28.92	Manufacture of machinery for mining, quarrying and construction	188		
28.93	Manufacture of machinery for food, beverage and tobacco processing	199		
28.94	Manufacture of machinery for textile, apparel and leather production	102	0	
28.95	Manufacture of machinery for paper and paperboard production	74	0	
28.96	Manufacture of plastic and rubber machinery	185		
28.99	Manufacture of other special-purpose machinery n.e.c.	1057		
29.10	Manufacture of motor vehicles	79		
29.20	Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers	332	0	
29.31	Manufacture of electrical and electronic equipment for motor vehicles	78		
29.32	Manufacture of other parts and accessories for motor vehicles	533	0	
30.11	Building of ships and floating structures	41	0	
30.12	Building of pleasure and sporting boats	29	0	
30.20	Manufacture of railway locomotives and rolling stock	62	0	
30.30	Manufacture of air and spacecraft and related machinery	90	0	
30.40	Manufacture of military fighting vehicles	8	0	
30.91	Manufacture of motorcycles	24	0	
30.92	Manufacture of bicycles and invalid carriages	43		
30.99	Manufacture of other transport equipment n.e.c.	9	0	0
31.01	Manufacture of office and shop furniture	317		
31.02	Manufacture of kitchen furniture	71		
31.03	Manufacture of mattresses	39		

Sector	Description	No. of companies[65]	DiD[66]	RDD[67]
31.09	Manufacture of other furniture	498	0	
32.11	Striking of coins	7	0	
32.12	Manufacture of jewellery and related articles	52		
32.13	Manufacture of imitation jewellery and related articles	8		
32.20	Manufacture of musical instruments	52		
32.30	Manufacture of sports goods	67	0	
32.40	Manufacture of games and toys	49		
32.50	Manufacture of medical and dental instruments and supplies	1205		
32.91	Manufacture of brooms and brushes	55		
32.99	Other manufacturing n.e.c.	122	0	
33.11	Repair of fabricated metal products	137		
33.12	Repair of machinery	496		
33.13	Repair of electronic and optical equipment	45		
33.14	Repair of electrical equipment	116		
33.15	Repair and maintenance of ships and boats	44		
33.16	Repair and maintenance of aircraft and spacecraft	47		
33.17	Repair and maintenance of other transport equipment	50		
33.19	Repair of other equipment	21		
33.20	Installation of industrial machinery and equipment	665		

Source: Own illustration, Deloitte (2024).