Evaluation Plan

for the funding guideline

‘National directive on measures to avoid carbon leakage in the national fuel emissions trading system‘

(*BEHG-Carbon-Leakage-Directive - BECV*)

Federal Ministry for Economic Affairs and Climate Action

1. Brief description of the funding guideline to be evaluated

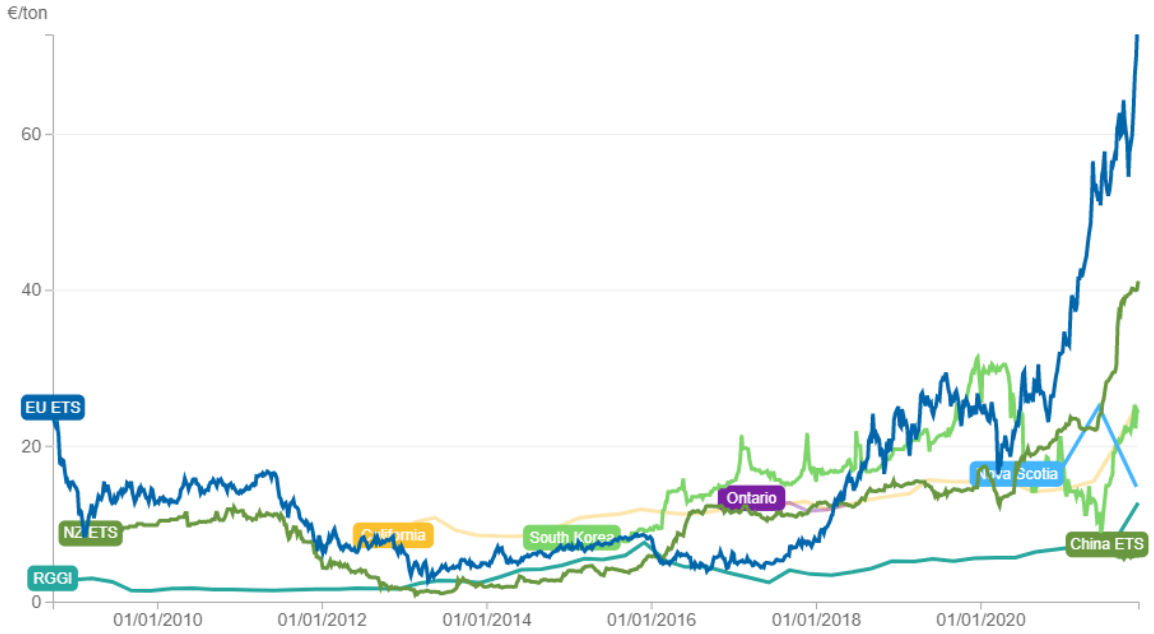
a) Carbon pricing and the risk of carbon leakage

Carbon pricing is a key element in the EU climate policy mix to drive investment into climate-friendly, low carbon technologies and to provide economic incentives for emissions reductions. For this purpose, the EU introduced the EU Emissions Trading System (EU ETS) in 2005, thus creating a market for greenhouse gas emissions allowances. The EU ETS is a so-called “cap and trade” system that sets an annual cap on the total number of emissions allowances. The allowance price increases steadily as the cap is subsequently lowered and fewer allowances are auctioned. The EU ETS covers emissions mainly from stationary sources in the energy and industry sectors. Starting in 2021, Germany’s Fuel Emissions Trading Act (*Brennstoffemissionshandelsgesetz* – BEHG) has established a separate, national emissions trading system (*nationales Emissionshandelssystem* – nEHS) that complements the EU ETS by pricing all of Germany’s fuel-based emissions not covered by the EU system. The national system mainly comprises emissions from the heating and mobility sectors. This includes small industrial plants that fall below the capacity thresholds of the EU ETS and are thus excluded from the latter.

Both systems may have adverse economic effects for the companies covered by each respective system. As they pass on the increased costs of the CO_2-price to their customers, companies that are covered by either system and compete in international markets will experience a deterioration of their competitiveness and thus lose market shares if their competitors are not subject to a similarly high carbon price.

Emissions trading therefore involves the risk that certain sectors and subsectors are forced to transfer their production activities to regions outside the EU with less ambitious climate policies, thus increasing emissions in those regions while eroding the industrial base in the EU (so called ‘carbon leakage‘). This is exacerbated by the fact that very few countries outside the EU have established their own emissions trading systems (see Figure 1). In these systems, prices and sectors covered by carbon pricing are substantially lower and less comprehensive than in the EU ETS and nEHS.

Figure 1: Allowance prices in € per ton CO2-equivalent, 2008-2021



Source: ICAP Allowance Price Explorer (2021)

b) *Concept and objectives of the funding guideline*

The BEHG-Carbon-Leakage-Directive (*BEHG-Carbon-Leakage-Verordnung* – BECV) aims to address the threat of carbon leakage under the nEHS by establishing a compensation scheme that builds directly on the foundation of the EU ETS based carbon leakage protection system. The EU ETS protection system employs so-called ‘free allocation’: Owners of installations, such as companies, receive emissions allowances free of charge if their installations pertain to economic sectors that

are deemed to be at risk of carbon leakage. The BECV on the other hand is a direct compensation scheme that can be compared with the so-called electricity price compensation under the EU ETS: Companies can apply to receive part of the cost increases reimbursed. The reason for this systemic difference is that under the EU ETS, 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, which release the fuels for consumption) to purchase emission allowances. 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. 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 deemed to be at risk of carbon leakage.

Apart from this technical difference, the BECV applies the main mechanisms of the EU ETS carbon leakage protection system, and adapts them, where necessary to the national context of the nEHS. As with the EU ETS, the BECV identifies the same list of sectors to be deemed at risk of carbon leakage, with the possibility of Non-EU-ETS sectors to apply for being included if they can prove a risk of carbon leakage via specific criteria. Companies that are covered by the nEHS and pertain to sectors on the list can then apply for a partial compensation of their eligible amount of emissions times the respective CO2-price. As in the EU ETS, the compensation amount is weighted by the so-called benchmark approach: Companies that do not employ the best available technology receive less compensation. In addition, the BECV employs sector-specific compensation degrees that range between 65 and 95% (depending on the given sector's emissions intensity), and further weigh and reduce each company's compensation amount.

Under the BECV, companies that receive compensation are obliged to demonstrate that they operate energy or environmental management systems and invest the majority of the compensation received (2023, 2024: at least 50%, from 2025 onwards: at least 80%) into energy efficiency and climate protection measures. This

ensures that compensation aimed at reducing the risk of carbon leakage also goes towards climate protection.

2. Evaluation method

Any rigorous policy evaluation will have to assess two central aspects: did the policy deliver on its main objectives and did it do so in an efficient, cost-effective manner? An ideal evaluation approach for the BECV would thus seek to address three fundamental research questions:

1. Does the BECV prevent carbon leakage and protect companies from any adverse competitiveness effects?

2. Do the obligations of the BECV lead to higher investments into energy efficiency or climate protection measures in Germany thus contributing to emissions 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?[1]

In addition, and related to research question 1, another aspect of the evaluation would be the assessment of the impacts of the nEHS itself on carbon leakage and competitiveness.

In recent years, micro-econometric studies have made substantial inroads into assessing the economic impacts of carbon pricing. A number of studies have evaluated the impact of the EU ETS on various dimensions of firm competitiveness such as employment (Petrick and Wagner 2014), revenues (Chan et al., 2013), productivity (Themann and Koch 2021) or innovation (Calel and Dzechezleprêtre 2016). In terms of carbon leakage, studies have investigated investment leakage (Koch and Basse Mama 2019), asset erosion (aus dem Moore et al. 2019) and plant relocation (Borghesi et al. 2018). The key challenge here is to isolate the effect of carbon pricing from any confounding factors that may also explain the outcome variable. For instance, foreign direct investment may not

[1] For a more nuanced view on these questions and a breakdown into evaluation questions and potential indicators, see sections 3 and 4.

only be explained by carbon pricing but particularly by the companies' competitive and economic environment or the companies' performance e.g. in terms of revenues or employment. Not controlling for these factors will yield confounded estimates of the impact of carbon pricing.

All these studies exploit the installation-level inclusion criteria of the EU ETS to compare firms that are very similar but differ in their regulatory status. For instance, the EU ETS will cover a steel plant if its production capacity is above 2.5 tons per hour. Hence, it is possible to find a sufficiently large control group of firms that are very similar to a sample of EU ETS firms in a number of characteristics (e.g. 2 to 4 digit NACE sector, asset structure, revenues) except for the exact size of their installations. Aus dem Moore et al. (2019) show that this can result in sample sizes of up to more than 2.000 EU ETS manufacturing firms with more than 1.200 firms constituting the control group.

In the context of competitiveness, recent studies built on this concept and applied quasi-experimental techniques to obtain more credible estimates based on country specific administrative data (e.g. Petrick and Wagner, 2014) or commercial databases (e.g. Marin et al., 2018). A combination of matching and difference-in-differences estimators as well as controls for country- and time-specific characteristics has allowed these studies to account for a variety of potential confounding factors, thus helping in the attempt to recreate the conditions of a randomized experiment.

Despite these advances on assessing the impacts of emissions trading per se, there is still a notable lack of studies on the impacts, design and effectiveness of compensation schemes to protect against carbon leakage. The main reasons for this are (i) a lack of a suitable control group, i.e. insufficient variation in the regulatory status, and (ii) data restrictions. These challenges apply in particular to the evaluation of the BECV.

The BECV regulates admission to compensation at the sector level. Any firm that is part of a sector deemed at risk of carbon leakage according to the BECV can apply for and is admitted to receive compensation. Hence, it is unlikely to find a suitable control group, i.e. a group of firms that are both subject to carbon pricing under the nEHS and part of a sector admitted to compensation under the BECV but do not in fact receive compensation. An exception to this rule are schemes that work with eligibility thresholds at the firm or

installation level (such as energy tax exemptions), thus allowing for a differentiation between non-regulated and regulated firms along the eligibility threshold and a thorough econometric ex-post evaluation (e.g. Gerster and Lamp 2020). Again, this is not the case for the BECV, since admission is universal for each sector deemed at risk of carbon leakage. The main reason for this design choice of the BECV is that based on data and administrative restrictions it would simply not be possible to thoroughly determine the risk of carbon leakage for an individual firm (Fowlie and Reguant 2018).

A similar problem arises when assessing the potential impact of the nEHS itself on carbon leakage and competitiveness. The very purpose of the nEHS is to close any gaps left by the EU ETS, i.e. pricing all fuel emissions not covered by the EU ETS in Germany. Again, there is no apparent treatment variation precisely because all firms face a carbon price. Given these substantial challenges, a clear and robust identification of potential impacts of both the BECV and the nEHS may not be possible.

However, there might exist some avenues into providing meaningful estimates on the potential effects of the BECV and the nEHS. For instance, while treatment status both in the BECV and the nEHS does not vary between relevant comparison groups, treatment intensity might in some cases. Under the nEHS, firms currently face a lower carbon price compared to their bigger counterparts under the EU ETS. In rebuttal, under the BECV firms face a more sizeable portion of the carbon price, since the partial compensation is lower than under the EU ETS protection system. Given regulatory and data restrictions, an approach that focuses more on descriptive, quantitative and qualitative as well as process-based analyses may provide a more straightforward and meaningful way into assessing the potential impacts of the BECV. This may particularly be the case for assessing (cost-) effectiveness and (administrative) efficiency.

In sum, an effective evaluation of the BECV requires a comprehensive assessment of methods as well as regulatory and data restrictions. The structure of the evaluation under this evaluation plan thus follows a three-step approach:

(i) the development of an adequate research design,

(ii) conducting the evaluation based on the research design and

(iii) the development of an evaluation report.

The Federal Ministry for Economic Affairs and Climate Action (*Bundesministerium für Wirtschaft und Klimaschutz* – BMWK) will publish a call for proposals on all these three elements. The selected external evaluation contractors will deliver inputs for each of these elements. BMWK seeks to identify the most adequate approach for the evaluation of the BECV in cooperation with the contractors. BMWK will define the exact requirements for the tender subsequently. BMWK expects to generate further ideas on the evaluation itself based on the delivered proposals.

Development of an adequate research design

For this purpose, a thorough assessment on the possibilities of different evaluation methods in light of the specific design features of the BECV will be conducted. This assessment will include an analysis of suitable data sources and their limitations (see section 5).

Examples of potential quasi-experimental designs may include:

Matched Difference-in-Differences combines two methods: the Difference-in-Difference procedure to account for unobserved characteristics, and a matching procedure to select the control group to account for observed characteristics. Thereby, this method seeks to account for any unobservable or observable shock that may confound the estimate of the impact of the BECV.

Instrumental variables may account for potential endogeneity issues: For instance, program participation (i.e. compensation under the BECV) may explain the risk of carbon leakage or the amount of FDI in response to carbon pricing. However, carbon leakage risk may also explain the likelihood to be covered by the BECV. Program participation may also be explained by other, unobserved factors. In both cases, this would lead to a spurious correlation and hence confounded estimates of the potential impacts of the BECV. An instrumental variable is correlated to program participation but is, for instance, not affected by the dependent variable (e.g. carbon leakage risk) or any unobservables.

Regression discontinuity designs appear unlikely to work in the given context, as there are no relevant cut-off rules in the BECV that might allow for a separation between compensated firms and non-compensated firms.

Synthetic control methods rely on the construction of a weighted combination of groups of firms used as controls, to which the group of firms covered by the BECV may be compared. This approach might provide an avenue into assessing the impacts of the BECV, e.g. by including firms from other EU member states that face a carbon price for the Non-ETS sectors, but that are not subject to a protection system similar to the BECV.

Randomized controlled trials, another method discussed in the European Commission's working paper and the "gold standard" in evaluation research, is not applicable to the given policy context. Selection into the compensation scheme of the BECV is clearly not random but the result of sector-specific admission criteria.

If quasi-experimental research designs turn out to be not applicable to the context of the BECV, an alternative approach will be developed. This approach can include for instance classic regressions designs, descriptive data analysis, qualitative analysis, process analysis, structural estimations and micro simulation models. Structural estimations and microsimulations may come with certain advantages given that they allow to model potential carbon leakage flows and channels based on already established empirical evidence that can then be fed with panel data. These methods may also be relevant to model and assess different design options for the BECV in terms of their effectiveness. Modelling results may also be compared with real life outcomes from the BECV, e.g. in terms of employment or other result indicators (see section 4), to obtain indications on potential reform possibilities. Other options may include insights from CGE modelling or macro-econometric back-casting methods if adequate. In addition, the research design will consider the employment of sector level data such as from Eurostat and Destatis as an alternative or complementary to firm level data.

In sum, the research design will take into account the most recent state-of-the-art research in terms of methodology, data and empirical results and adapt these insights to the given policy context of the BECV.

Evaluation report

The evaluation report will describe the evaluation process and the research design and present the evaluation results. It will discuss the evaluation results in light of potential

regulatory improvements for the BECV. The report will discuss these potential improvements referencing the three research questions described at the beginning of section 2 and the corresponding indicators described in section 4. Given the fact that any micro-econometric ex-post evaluation will need at least three years (i.e. 2023, 2024, and 2025) of data after the implementation of the BECV in mid-2022 to assess the effectiveness of the compensation scheme, the time frame of the evaluation will have to be well synchronized with the final research design (see sections 6 and 7).

3. Evaluation questions

The evaluation should provide information on whether and to what extent the BECV has achieved its objectives. For this purpose, BMWK developed the following guiding evaluation questions. The evaluation questions are meant to broadly address the three fundamental research questions described in section 2: Does the BECV

(i) prevent carbon leakage and/or adverse competitiveness effects;

(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 section 2, the degree to which the evaluation can answer these questions will depend on the final research design. For instance, an ex-post evaluation using micro-econometric methods to assess research question (ii) may not be possible due to a lack of firm level data on energy efficiency and/or emissions or the lack of a suitable control group.

BMWK will thus further refine the evaluation questions based on the call for proposals, the selected proposal including the final research design, as well as in accordance with the external evaluation contractors.

	Evaluation question
Target achievement	• Whether and to what extent did the BECV achieve its objectives?

	• How can the effects be classified and evaluated in an overall economic view?
Impact monitoring	• To what extent was the BECV responsible for effects that have been achieved? • How do specific design choices of the BECV contribute to this?
Cost-effectiveness	• Are the processes for implementing the programme on target? • To what extent do the operational programme implementation and the compensation scheme meet the requirements of the aid recipients? • What are the actual administrative costs and what share do they have in the overall budget of the BECV? • Is a (qualitative / quantitative) adjustment of the current compensation measure necessary and useful? • What is the benefit of the BECV in relation to other compensation schemes / carbon leakage protection schemes?
Policy design	• To what extent does the BECV contribute to carbon leakage protection in the future?

	• Can potential BECV design changes improve results?

4. Result indicators

This section aims to break down the evaluation questions into a set of potential quantitative indicators that may be used in the evaluation. The indicators described here are of an exemplary nature and give an intuition on how the final set of indicators could look like. In accordance with the three fundamental research questions (see section 2), we divide the indicators into three subsets:

(i) climate protection,

(ii) carbon leakage and competitiveness and

(iii) cost-effectiveness.

The focus will be on potential direct effects, although the evaluation will also consider indirect effects such as spillover effects. The reason for this is that the propensity for indirect effects of the BECV may be rather low. Unlike schemes that include eligibility thresholds, we do not expect firms in BECV-sectors not to receive compensation, which decreases the potential for intra-sector spillovers. In addition, competition effects appear to be less likely: Most firms likely compete within their main sector. Since firms that operate within the same NACE rev.2 4-digit sector receive the same compensation factor, the BECV is less likely to distort competition among these firms. In addition, firms receive their compensation based on their actual emissions emitted via fuel consumption.

The final set of result indicators will also consider indicators that may help to improve the design of the BECV, both in the three subsets as well as with respect to indicators measuring indirect effects.

As with the evaluation questions (see section 3), the final set will depend on the result of the data availability assessment (see section 5) and the final research design. For in-

stance, a lack of firm level data on energy efficiency and/or emissions intensity may impede to identify any impacts using econometric techniques. However, some alternative indicator at the sector level, such as emission intensity, may be used, e.g. for a descriptive or econometric analysis.

In terms of the time span, both years before and after the introduction of the nEHS and the BECV will be considered. If the final research design will apply an ex-post evaluation using micro-econometric techniques, this will require at least three years of ex-post data and three years of ex-ante data, i.e. before the introduction of the nEHS (2021) and the BECV (with 2022 as the first application year).

BMWK will further refine the result indicators based on the call for proposals, the selected proposal including the final research design, as well as in accordance with the external evaluation contractors. As of now, BMWK expects that the majority of indicators will be reported in an annual format.

Objective	**Result Dimension**	**Result Indicators**

(i) Climate protection	○ Reducing emissions and contributing to the transition towards low-carbon technologies
	○ Contributing to more resilience with respect to carbon leakage
	○ Increasing investment activities
		○ direct emissions
		○ direct emissions intensity
		○ energy consumption
		○ energy efficiency
		○ fossil fuel consumption
		○ tangible fixed assets
		○ value added
		○ investments
		  ○ into climate protection measures
		  ○ into energy efficiency measures
		  ○ into climate protection measures, within energy and environmental management system
		  ○ into energy efficiency measures, within energy and environmental management system

(ii) Carbon leakage and competitiveness	○ Reducing the risk of carbon leakage stemming from the nEHS ○ Avoiding negative competitiveness effects stemming from the nEHS	○ value added, production volume ○ revenues ○ number of employees ○ tangible fixed assets ○ market share ○ total factor productivity (TFP) ○ foreign direct investments (FDI) ○ direct emissions intensity
(iii) Cost-effectiveness	○ Ensuring cost-effective carbon leakage protection	○ BECV budget ○ allocated BECV compensation ○ total auction volume nEHS ○ compensation as % of total auction volume nEHS

5. Data sources

Part of the development of a thorough research design (see section 2) will be a comprehensive assessment of adequate data sources. The assessment will take into account

(i) relevance to the research design, evaluation questions and result indicators,

(ii) quality of the data,

(iii) scope in terms of companies and/or sectors covered,

(iv) selection of outcome and independent variables,

(v) preparation and cleaning of raw data, and

(vi) matching of different datasets.

The evaluation will consider three main data sources in particular:

(i) firm level data,

(ii) sector level data and

(iii) regulatory data.

Examples for potential databases used to derive the dataset are:

Firm level data:

- Administrative firm panel data for Germany (AFiD, Amtliche Firmendaten für Deutschland)
- Commercial firm panel data such as Orbis or Amadeus

Sector level data

- Eurostat Structural Business Statistics (NACE rev.2 4-digit)

Regulatory data

- BECV regulatory data as compiled by the German Emissions Trading Authority (DEHSt) (e.g. on compensation paid, compliance with BECV obligations on investments into climate protection and energy efficiency), first batch available by end of 2023

The data assessment will also take into account the timing of data releases of the given data sources. We expect most data sources to report with a time lag of at least one year.

6. Evaluation procedure

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

1. According to § 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. § 26 (2) BECV defines that from 2022 and annually thereafter, the competent authority will also consult the interest groups active for affected sectors or subsectors, the 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 § 26 BECV (3), 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 § 26 BECV (3), one focus of this evaluation shall be:

   (i) if the carbon leakage indicators for the quantitative and qualitative assessment pursuant to §§ 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 as well as an intra-year disbursement of the aid are necessary.

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

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

BMWK will assess based on the call for proposals, the selected proposal including the final research design, as well as in accordance with the external evaluation contractors the best way to integrate the evaluation in accordance with this evaluation plan into the existing evaluation processes. Given the time frame and content, the evaluation defined in § 26 BECV (3) appears to be a potentially good framework for this.
If the final research design applies an ex-post evaluation using micro-econometric techniques, this will require at least three years of ex-post data. The BECV is supposed to enter into effect in mid-2022 in order to ensure compensation for the accounting year 2021 can be granted in due time before the end of 2022 in compliance with EU state aid requirements. Hence, years for the post-treatment period would need be at least 2023, 2024 und 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 micro-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 § 26 BECV (3), to be carried out until September 30, 2028, could thus provide a good format 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 § 26 BECV (3). The first report for § 26 BECV (3), to be carried out until September 30, 2024, could be used to integrate a progress report that predates the evaluation plan and explains the research design, empirical questions and result indicators.

In that regard, the evaluation report will be also subject to § 26 BECV (4) 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 this evaluation plan. 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.

7. Time frame

The BECV entered into force - subject to the reservation of approval by the European Commission under state aid law provided for in Section 27 of the BECV - on July 28, 2021, pursuant to Section 28 of the BECV. After the European Commission has notified the BECV, the ordinance will be fully applied. In accordance with § 13(1) BECV, applications for the accounting year 2021 must be submitted to the competent authority (DEHSt) by June 30, 2022.

BECV regulatory data as compiled by DEHSt will be available by the end of 2023 (see section 5). If the final research design applies an ex-post evaluation using micro-econometric techniques, BMWK expects the analysis to start at the earliest at the beginning of 2027 (see section 6).

The selection of the evaluation body will be put out to public tender in 2023. After completion of the tender, the evaluation body will file a progress report in 2024 and the evaluation report in 2028.

BMWK will review and if necessary adjust this timeline based on the call for proposals, the selected proposal including the final research design, as well as in accordance with the external evaluation contractors the best way to integrate the evaluation in accordance with this evaluation plan into the existing evaluation processes.

8. Publication

BMWK and DEHSt will publish each of the reports described in section 6 on their respective websites. The published results of the evaluation in accordance with this evaluation plan 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.

9. Literature

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