Draft evaluation plan for
"Guidelines for Federal support for energy and resource efficiency in the economy"
# of the Federal Ministry of Economic Affairs and Energy

1 Introduction

1.1 Background

With the energy transition, the Federal Republic of Germany has embarked on a major and profound transformation of its energy supply and energy use. In the Federal Climate Protection Act, as amended in 2021,[1] the Federal Government set itself the target of reducing greenhouse gas emissions by at least 65 % by 2030 compared to the 1990 base year and committing itself to corresponding reductions at international and EU level. By 2040, CO2 emissions are to be reduced by 88 % and net-zero greenhouse gas emissions by 2045.

In addition to the expansion of new generation capacity for electricity based on renewable energy sources and the associated infrastructure (networks, storage), reducing energy consumption by increasing energy efficiency is at the heart of the energy transition. The measures taken to achieve national and EU-wide energy and climate objectives in Germany have been set out in various programmes. At national level, these include in particular the Energy Efficiency Strategy 2050 and the Climate Action Programme 2030, at EU level the National Energy and Climate Plan and reporting under the Energy Efficiency Directive. The measures implemented so far to achieve these climate and energy targets have made significant progress on climate change mitigation and energy efficiency, e.g. reducing greenhouse gas emissions in industry by around 34 % between 1990 and 2019. Nevertheless, scientific analysis shows that further efforts are needed to meet the binding 2030 targets.

Figure1: Annual emission levels by sector up to 2030 (BMU)

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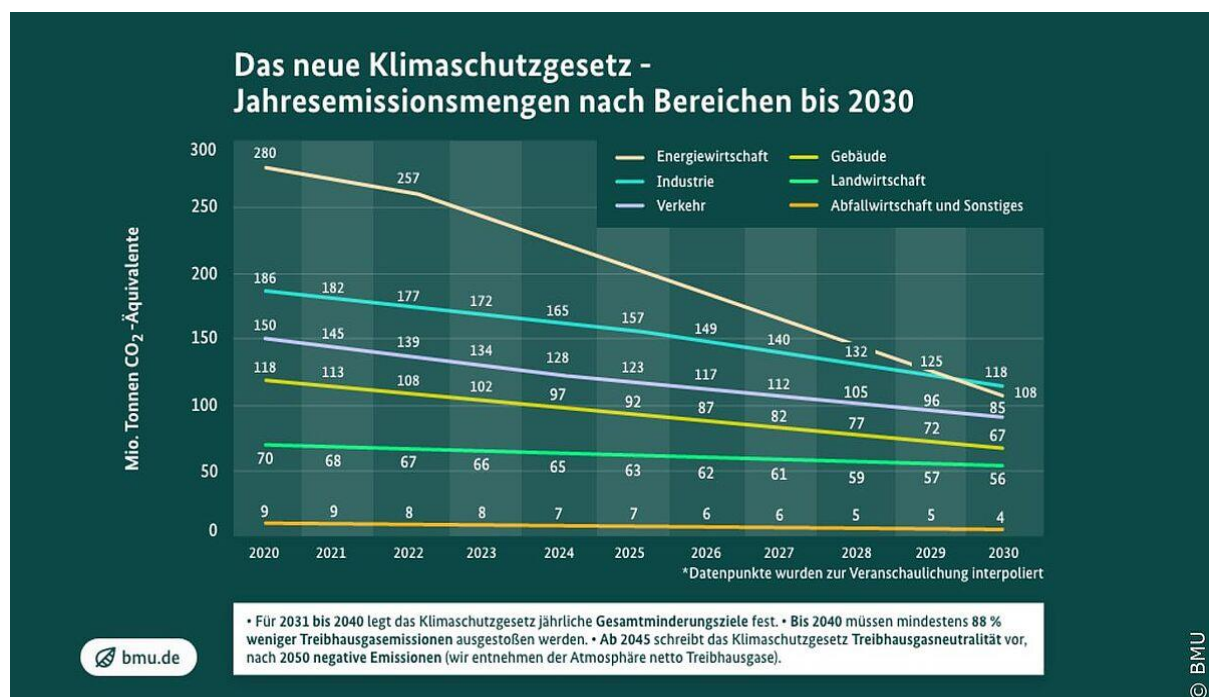
[1] First Act amending the Federal Climate Protection Act of 18 August 2021. BGBl. Part I No 59, p. 3905 et seq.

The industry sector accounted for around 28 % of Germany's final energy consumption in 2019[2] (AGEB 2020) and around 23 % of Germany's greenhouse gas emissions (from the energy use of fuels and industrial processes[3]). This sector is therefore the second largest emitter of greenhouse gas emissions in Germany after the energy sector. In order to make tangible progress in reducing final energy and resource consumption and reducing CO_2 emissions, more investments are needed to increase energy and resource efficiency and the use of renewable energy for process heat, contributing to the objective of net-zero greenhouse gas emissions in 2045. However, such investments are usually not part of the core business of companies, compete with alternative investment options and need to meet ambitious expectations of profitability in the form of short payback periods. This is often not the case without public support.

In view of the objectives laid down in the Climate Change Act for the industry sector, the support programmes summarised in the Federal Promotion for Energy Efficiency in the Economy (EEW) are of particular importance. By standardising funding conditions and funding from a common budget title in the Energy and Climate Fund, a simpler and more user-friendly funding model was created in 2019 and proved successful with its various modules. In the first two years since the launch of the EEW, more than 18 000 applications for support have been approved. The projects carried out achieved an annual saving of more than 1.3 million tonnes of CO2.

In October 2021, the two funding guidelines governing the programme were amended and extended and entered into force on 1 November 2021[4]. In particular, support will also be given to actions in the field of resource efficiency and long-term transformation planning. The programme is therefore renamed "Bundesförderung für Energie- und Resource Efficiency in der Wirtschaft" (Bundesförderung für Energie- und Resource Efficiency in der Wirtschaft). Only the 'Guidelines for Federal support for energy and resource efficiency in the economy — grant and credit' are relevant to the evaluation plan submitted here.[5] Since the funding competition follows a competitive procedure, the legislature considers that no evaluation plan is required for this part of the programme. The 'grant and credit' funding guidelines deliberately pursue a largely technologically open and cross-sector approach. The support may be granted either as a direct grant (BAFA) or as a repayment grant in conjunction with borrowing from Kreditanstalt für Wiederaufbau (KfW). With these funding options, the Federal Ministry of Economic Affairs and Energy (BMWi) takes into account the different financing needs of companies.

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[2] AGEB: Evaluation tables on the energy balance for the Federal Republic of Germany 1990 to 2020 (situation at September 2021). https://ag-energiebilanzen.de/10-0-Auswertungstabellen.html.

[3] Federal Environmental Agency: Last year's estimate of German greenhouse gas emissions for 2020. As of 15 March 2021. https://www.umwelt-bundesamt.de/dokument/emissionsuebersichten-in-den-sektoren-des.

[4] Guidelines for Federal Support for Energy and Resource Efficiency in the Economy — Grant and Credit of 12 October 2021 (BAnz AT 29.10.2021 B2) and Guidelines for Federal Support for Energy and Resource Efficiency in the Economy — Promotion Competition of 1 October 2021 (BAnz AT 29.10.2021 B1).

[5] The following comments therefore relate only to the 'Guidelines for Federal Support for Energy and Resource Efficiency in the Economy — Grant and Credit'.

1.2 Notification of an evaluation plan

Support under the EEW is State aid to promote environmental protection, which aims to achieve a more efficient use of energy and thus reduce the release of anthropogenic greenhouse gas emissions. An evaluation plan is notified for aid under the EEW, which is covered by the Block Exemption Regulation (GBER). The aid amendment is based on the rules on environmental aid (GBER, Articles 36, 38, 41 and 46).

Under Article 1 of the GBER, an evaluation plan is required if the 'average annual budget' of a support programme is above EUR 150 million.

For the guidelines on 'Federal support for energy and resource efficiency in the economy — grant and credit' on which this evaluation plan is based, funding is provided from the Energy and Climate Fund, a special investment fund. There is no provision for an exact annual budget. The budget shall be adjusted annually in accordance with the principles of the budgeting process and shall be based, inter alia, on the demand for support. It is therefore necessary to interpret the term 'average annual budget'. In our view, these are the funds actually spent in the relevant year and covered by the GBER. This means that the expenditure is in line with Table1 the rules.

Table1:

Year	Budget
2019	EUR 1.25 million
2020	EUR 23.2 million
2021 (as at 31.10.21 — old aid scheme)	EUR 62.6 million
Average	**~ EUR 29 million**
2021 (forecast from 01.11. to 31.12.21-revised aid scheme)	EUR 11 million
2022 (forecast)	EUR 225 million
2023 (forecast)	EUR 270 million
2023 (forecast until 30.06.)	EUR 200 million
Average	**~ EUR 176.5 million**

As a result of the increase in the number of applications and the amendment made on 1 November 2021 and the improvement and extension of the funding conditions of the Funding Guidelines, the aforementioned threshold of EUR 150 million will be exceeded in the near future. Accordingly, an evaluation plan for the above-mentioned amended funding guidelines is submitted.

Article 2 of the GBER defines the following minimum information for the evaluation plan:

- Objectives of the aid scheme to be evaluated
- Evaluation questions
- Result indicators
- Evaluation method envisaged

- Data collection criteria
- Planned timetable
- Description of the independent body
- Criteria and modalities for publicising the evaluation

A corresponding evaluation plan is intended to provide ex ante guidance to the authorities involved in planning and carrying out evaluations. In addition, it aims to assess ex post the positive and negative effects of the aid scheme, i.e. how the effects achieved are to be compared with effects on trade and competition. The key is the assessment of the direct incentive effect of the aid on the aid recipient, a balancing of positive and negative effects of the aid scheme, an analysis of the achievement of the policy objectives pursued and an assessment of the appropriateness of the implementation. The aim is to verify whether the assumptions made in the notification are correct and what aspects need to be further developed. Accordingly, the evaluation is not intended to serve purely ex-post consideration, but is intended to accompany implementation but, taking into account possible delays in the effects, to improve ongoing aid, in this case the 'Guidelines for Federal Support for Energy and Resource Efficiency in the Economy — Grant and Credit'.

2   The Funding Guidelines

2.1   Federal support for energy and resource efficiency in the economy — grant and credit

The grant of aid under the Funding Guidelines takes the form of part-financing by means of a grant or loan variant. Under the grant variant, the companies receiving the aid receive pro rata support through a non-repayable grant. In the case of the loan variant, on the other hand, a repayment subsidy is granted on the amount of the loan.

The basic content and structures are based on funding programmes of the Federal Ministry of Economic Affairs and Energy, which have generally been proven for many years and which were summarised, adapted and tailored to target groups in 2018 in the Federal Promotion for Energy Efficiency in the Economy. On the 17th day of the year. Four support modules were published[6] in December 2018:

- Cross-cutting technologies;
- Process heat from renewable energy sources,
- Measurement, control and control techniques, sensors and energy management software;
- Energy-related optimisation of installations and processes (technology open).

The recast Directive[7], which entered into force on 1 November 2021 and which is the subject of this evaluation plan, also includes the promotion of transformation concepts and the inclusion of the theme of resource efficiency:

- Cross-cutting technologies;
- Process heat from renewable energy sources,
- Measurement, control and control techniques, sensors and energy management software;

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[6] Guidelines for the promotion of energy efficiency and process heat from renewable energy in the economy — Grant and credit ('Energy efficiency in the economy — Grant and credit') of: 17/12/2018 (BAnz AT 31.12.2018 B1)

[7] Guidelines for Federal support for energy and resource efficiency in the economy — Grant and credit of 12 October 2021 (BAnz AT 29.10.2021 B2)

- Energy <u>and resources</u>optimisation of facilities and processes (open technology measures); and

- <u>Concepts of transformation</u>.

Module 1 'Cross-cutting technologies' supports individual investment measures to improve the energy efficiency of industrial and commercial installations and processes through the use of highly efficient technologies available on the market. These technologies include electric motors and drives, industrial and professional pumps, fans, compressed air generators, heat transferors for waste heat recovery or heat recovery, and insulation of industrial installations or sub-installations. The selection of eligible technologies will be reviewed annually and, if necessary, supplemented/amended. The measures must comply with binding technical requirements which are higher than the minimum market standard and are presented in an additional leaflet. The net investment volume shall be at least EUR 2000 and the maximum amount of support shall be EUR 200 000 per project. The funding rate shall not exceed 30 % of the eligible costs and 40 % for small and medium-sized enterprises (SMEs).

Module 2 'Procedural heat from renewable energy sources' supports measures for process heat production from solar collector plants, biomass installations and heat pumps, provided that they use renewable energy sources within the meaning of Article 2(110) of the GBER. The measures shall comply with mandatory technical requirements set out in an additional leaflet. The maximum amount of funding is EUR 15 million. The funding rate shall not exceed 45 % of the eligible costs and 55 % in the case of SMEs.

Module 3 'Measuring, control and control technology, sensory and energy management software' promotes the acquisition and installation of measurement, control and control techniques and sensors for monitoring and efficient management of energy and material flows, as well as the acquisition and installation of energy management software, as well as the training of personnel by third parties in the use of the software insofar as they are directly related to installations and processes. The measures shall comply with mandatory technical requirements set out in an additional leaflet. The maximum amount of funding is EUR 15 million. The funding rate shall not exceed 30 % of the eligible costs and 40 % in the case of SMEs.

Module 4 'Energy and resource optimisation of installations and processes' supports investment measures for energy and resource-oriented optimisation of industrial and commercial installations and processes that contribute to increasing energy or resource efficiency or reducing and avoiding fossil-based energy consumption or $CO2_{intensive}$resources in companies. The investment measures shall be compatible with the objective of net-zero greenhouse gas emissions in 2045 and shall not entail lock-in effects in relation to fossil technologies. In addition, the (energy-related) amortisation period of the entire project without receiving support must exceed three years in total. In detail, the following are eligible under this module:

- Process and process transformations leading to energy and resource savings, such as the use of efficient equipment and machinery, the replacement of individual components, and the energy and resource-oriented optimisation of process management or process.

- Measures to use process waste heat, such as the integration of waste heat for the provision of heat, including all necessary measures in plant or building technology, feeding into heat networks, including interconnectors, and electricity generation of waste heat (e.g. Organic Rankine Cycle (ORC) technology).

- Measures in installations for heating, cooling and ventilation are eligible, provided that they are clearly and predominantly used for the production, processing or processing of products.

6

- Measures for the energy efficient provision of process heat or cold, such as energy-efficient heat and cooling generator and optimisation of heat or cold storage.

- Measures to reduce or avoid energy and resource losses in the production process, such as insulation of installations and distribution lines, hydraulic optimisation, renewal of compressed air pipes or prevention of production waste.

- Cost of drawing up a savings plan by external energy consultants.

Unlike the previous modules, support under the module 'Energy and resource optimisation of installations and processes' is technologically open.

The maximum amount of funding is EUR 15 million. The funding rate shall not exceed 30 % of the eligible costs and 40 % in the case of SMEs. If the developed waste heat is used outside the farm, the production rate is 40 % (SME: 50 per cent). The maximum funding is EUR 500 (SMEs: EUR 900) per tonne of CO_2 saved annually (CO_2 $_{support}$cap). CO_2 —Savings from process heat production from renewable energy sources in accordance with Module 2 may be added to the calculation of the support efficiency.

The aim of **the 'transformation approach'** is to help companies plan and implement their own transition towards net-zero greenhouse gas emissions. By drawing up a transformation plan, it is also possible to request an extension of the timeframe for the implementation of investment projects under the Federal Support for Energy and Resource Efficiency in the Economy. The concept of transformation must be mandatory

- present the IST state of greenhouse gas (GHG) emissions or the GHG balance within the chosen balance limits;

- include a net-zero GHG target by 2045 at the latest;

- include a longer term GHG target (at least 10 years after application) and a specific GHG target (SOLL status) for the site(s) under consideration;

- include an action plan for achieving or transforming from IST to SOLL;

- Include savings concept(s) for at least one operation under Module 4 of the Funding Guidelines;

- ensure that the transformation concept is anchored in the corporate structure.

The maximum amount of funding is EUR 80 000. Support for transformation concepts is granted only as a non-repayable grant. The funding rate shall not exceed 50 % of the eligible costs and 60 % in the case of SMEs.

The target group of the Funding Guidelines are private and municipal undertakings and self-employed persons if the establishment is predominantly used for professional activities or contractors who carry out the measures referred to in the Directive for an eligible undertaking. Municipalities and their dependent own undertakings and undertakings or sectors in the cases referred to in Article 1(2) to (5) GBER are not eligible to apply.

The measures can be supported under the provisions of the de minimis Regulation and the GBER. Undertakings active in the primary production of agricultural products are excluded from support under the de minimis Regulation.

The support is granted in the form of a non-repayable grant (grant variant) or a repayment grant (credit variant). Only a non-repayable grant will support the transformation concepts.

The Federal Office for Economic Affairs and Export Control (BAFA) handles applications for the investment grant and the loan variant is managed by Kreditanstalt für Wiederaufbau (KfW). The promotion of transformation concepts is implemented through the VDI/VDE-IT as project promoter.

2.2   Objectives of the Funding Guidelines

The Directive on the Federal Promotion for Energy and Resource Efficiency in the Economy — Grant and Credit is intended to support the transformation of energy use in the German economy. In particular, it aims to reduce GHG emissions by reducing energy consumption, developing and using renewable process heat and increasing energy and resource efficiency. In this way, the programme aims to contribute to the achievement of national and EU-wide energy and climate targets and to the implementation of Article 7 of the EU Energy Efficiency Directive (EED), thus helping Germany to become climate neutral by 2045. For the Directive, the two objectives of "GHG reduction" and "reduction of (final) energy consumption" are accompanied by quantitative targets.

The target values for the entire Directive and its individual modules are, according to the BMWi's economic viability study, the annual Table2 target values set out in.

Table2:   **Target values of the 'Guidelines for the Federal Support for Energy and Resource Efficiency in the Economy — Grant and Credit' per year**

	Total	of which Module 1	of which Module 2	of which Module 3	of which Module 4
GHG reduction [in Mt CO2eq]	1,47	0,15	0,09	0,034	1,2
Energy saving or renewable energy production [in TWh]	3,77	0,57	0,009	0,11	3,06

To this end, an investment incentive will be provided. Operationally, the Directive aims to promote user-friendly, cross-sectoral and, to a large extent, technology-open, efficient and effective support.

The objectives of the Directive are logically based on each other. The Instrument Objectives structure the funding and contribute to the achievement of the main objectives, which in turn contribute to the achievement of the Mission. This target system Figure2 is presented in.

Figure 2: **Target system of the 'Guidelines for Federal Support for Energy and Re-
source Efficiency in the Economy — Grant and Credit'**

Dimension	Main aspect
Policy strategy	Supporting the transformation of energy supply and use (energy transition) towards the objective of net-zero greenhouse gas emissions by —Reducing GHG emissions — Development of renewable energy — Reducing energy and material consumption —Increasing energy and resource efficiency
	⇧
Main objectives	GHG reduction by: Increasing energy and resource efficiency Increase the share of renewable energy to deliver process heat
	⇧
Toolbox objectives	Incentive to invest efficient and effective promotion of necessary investments by — technology open, cross-sectoral — user-friendly support

2.3 Intervention logic of the Funding Guidelines

The Directive on Federal Support for Energy and Resource Efficiency in the Economy — Grant and Credit is a programme with economic intervention logic. Such measures, through economic incentives, trigger investments or other behavioural changes with direct efficiency-enhancing effects. This means that in the case of energy efficiency-related economic measures, for example, grants or interest subsidies support the investment of the target group in technical installations.

The Directive is based on a logical causal chain in the form of a model of effect. The impact model presents the interaction between funding and activities based on it, as well as their results up to the target contributions. In this context, the impact model represents a deliberate simplification of the influences on how to manage combinations of effects in the evaluation. The basic model of effect follows the logic Figure3 set out in.

Figure 3: **Basic impact model of the 'Guidelines for Federal Support for Energy and
Resource Efficiency in the Economy — Grant and Credit'**

Use of resources (in- sources (in-	→	Output (out- put)	→	Outcome (Outcome)	→	Impact (Impact)

The individual components of the active model can be described as follows:

Use of resources (input)

Support under the Directive is the primary impact input. The use of resources, i.e. the financial resources made available, is intended to provide the target group with an incentive to invest. The

main measure or indicator is the amount of budget/budget allocated to support and administration/implementation of the programme.

Output (output)

This allocation will lead to the direct performance of the programme. This includes the implementation/implementation of appropriate measures in the target group through the activation of investments on the ground. The output dimension focuses on operational objectives such as investment incentives or user-friendly/technology-open/cross-sector support.

Key measures and/or indicators are therefore the number of authorisations and the funding allocated to them, as well as the number of activities triggered by them (efficiency measures) or necessary investments by the target group for this purpose.

Outcome (Outcome)

The support and the investments/activities thus stimulated enable efficiency measures to be implemented among the target group. As a direct result of the support, the measures implemented will, for example, transform processes and thus save energy/resources or increase the share of renewable energy. In general terms, the result of funding is the efficient use of energy/resources.

The Outcome dimension includes the main objectives of the Directive, i.e. increasing energy and resource efficiency or increasing the share of renewable energy through the use of process heat.

The outcome dimension poses greater challenges to the evaluation, as the impact logics vary greatly from one another or are difficult to understand and compare because of complex funding items:

- Module 1 is characterised by the lowest challenges as it is technology-specific. Therefore, the supported measures are largely standardised and thus simply comparable, but typically also limited in scope/impact/target contribution.

- Module 2 is characterised by separation or combination with module 4. In the evaluation, account must be taken of the delimitation of the accounting space, i.e. which effects take place and are to be taken into account in accounting for the effects of the aided measure. Where appropriate, different effects on primary and final energy consumption shall be included.

- Module 3 has indirect effects: Measurement, control and control technology, sensory and energy management systems are used to control and control energy consumption. They thus optimise existing efficiency potential, but may depend on the implementation of additional measures such as cross-cutting measures.

- Module 4 is designed to be technologically open and also includes resource saving in addition to energy efficiency technologies. Because of the targeted support for complex systemic measures in this module, which may also include measures/technologies from Modules 1 and 3, the composition of the measures to be supported is very heterogeneous, as well as higher technical complexity and (significantly) higher investment/funding volumes. Challenges therefore represent a wide range of potential interactions in addition to the delimitation of the respective areas of impact (accounting space) of the measures. In particular with regard to resource efficiency, changes in resource use/substitution should also be taken into account where appropriate. This makes it much more difficult to compare the supported measures with each other, but also with those from other modules.

- The promotion of transformation concepts, similar to Module 3, is intended to have an indirect effect. The concepts design savings (IST-SOLL difference in GHG emissions), i.e. they

only need to be implemented with appropriate measures, if necessary in the context of support with other modules of the Funding Guidelines. The impact of the aided project is therefore indirect and temporal. A comparison or summation with the savings from the other modules is limited or not possible.

Key measures or indicators of the outcome dimension are the developed or saved GHG emissions, (fossil) quantities of energy or the higher share of renewable energy or other resources saved in the target group.

Effect (impact)

The funding results (outcome) give rise to indirect, intermediate and cross-cutting effects of the use of funds. This is an overarching (general/economic) impact of (collective) behavioural change and activities in the individual recipients of the aid.

The impact dimension thus addresses the funding objectives at mission level. The use of efficient technologies and processes saves energy in the target group (fossile), which in turn reduces demand for (fossil) energy in the energy system and thus reduces GHG emissions. It will also strengthen the market penetration of highly efficient technologies, paving the way for a climate-neutral Germany by 2045.

The main measures and indicators are therefore the aggregated energy/GHG savings and their distribution among individual energy carriers (fossil/renewable).

Figure4 summarises the main aspects of the effectiveness model of the Funding Guidelines.

Figure4: **Specific impact model of the 'Guidelines for Federal support for energy and resource efficiency in the economy — grant and credit'**

Dimension	Action step	Indicator
Input	Funding	expenditure on funding
	⇩	
Output	Incentive to invest	Funding cases
		volume of investment triggered
	⇩	
Outcome	Efficient use of resources	Primary/final energy savings
		Resource savings
		Increasing the integration of renewable energy process heat
	⇩	
Impact	Reduction of energy and resource needs	Reduction of primary/final energy consumption
		Reduction of resource use
	Reduction of CO_2emissions	Reduction of CO_2emissions
		Increase the share of renewable energy
	Accelerating market penetration of high-efficiency technologies	

2.4   Need for State intervention through the Funding Guidelines

More complex measures to increase efficiency and savings, which require technical transformations of complete process chains or the transformation of entire industrial sites, often face particular challenges. In many cases, when building improved process chains, certain aspects of their combination still need to be piloted or 'upgraded'. This is very time-consuming and involves very high costs and economic risks for companies (production loss or limited production). In particular, the initial lack of economic viability of innovative process technologies compared to conventional technologies in the current market environment hampers the transformation of industry towards net-zero greenhouse gas emissions and resource-efficient production. The expected costs remain high and are not economically viable for businesses, even if current and medium-term prices are taken into account in the EU ETS.

Moreover, as regards energy-intensive processes that are subject to the EU ETS, no emission reduction path beyond 2030 has yet been established in the ETS. This means uncertainty and reduced predictability for companies in the case of longer-term measures.

Companies, which necessarily act in their own economic interest, therefore do not have a sufficient incentive to invest in such technologies.

2.5   Expected effects of the Funding Guidelines

The aim of the 'Bundesförderung für Energie- und Resource Efficiency in the Economy — Grant and Credit' Directive is to encourage the necessary investments in the recipients of the aid in view of the energy and climate policy objectives. By launching some 54 000 projects to improve energy and

resource efficiency and to generate renewable energy to deliver process heat, the Directive aims to achieve the following objectives by the end of 2026:

- CO_2- Savings of 7.35 million tonnes
- Final energy savings of 18.8 terawatt hours

The support programme thus makes a concrete contribution to achieving the climate and energy targets and the implementation of Article 7 of the Energy Efficiency Directive (EED).

2.6 External factors with possible impact on the Funding Guidelines

In particular, the economic viability of eligible investments is considered to be a key factor with a significant impact on demand for support on the basis of the guidelines on 'Federal support for energy and resource efficiency in the economy — grant and credit' — and thus the achievable funding effect. As investment in energy and resource efficiency competes with a variety of alternative investment opportunities at company level, economic developments, energy and resource prices and, where relevant, the prices of emission allowances are particularly relevant.

In the case of good economic conditions, competition between (in-company) investment alternatives may decrease. At the same time, this can be accompanied by a decreasing importance of profitability as an assessment criterion and other soft factors (e.g. corporate image, values, etc.) can become more important for investment decisions. Investment also always involves entrepreneurial risks, which may lead to behaviour that avoids investment when assessing the economic/cyclical situation.

In addition, energy and resource prices have an impact on the planning and implementation of energy and resource saving measures. High prices make these measures more economical. CO_2 prices can be amplifying. This can be expected for the time being in the more energy-intensive sectors (EU ETS I) but also in other sectors (discussion on the reform of the EU ETS/fuel/ETS II). In general, energy and resource costs have an impact on the economic viability of production costs (including services) of existing and new technology (production cost difference), which vary according to the sector and the size of the enterprise. From a business point of view, this difference is one of the key levers for assessing the efficiency of (energy and resource efficiency) measures. If this assessment is unfavourable from the point of view of the target group or is negatively assessed by an uncertain situation, the risk of implementation or conversion is more likely to be avoided by the companies. The assessment of the economic viability of eligible investments is influenced to varying degrees, sometimes also by sector or position in the value chain.

2.7 Existing evaluation activities on the funding guidelines

At national level, the establishment of the Funding Guidelines is governed by the Federal Budget Code (BHO, §§23,44). Accordingly, the Federal Government must have a significant interest in the fulfilment of certain objectives in order to be able to award grants. The award may be audited by the Federal Court of Auditors (BRH). The requirements of the Federal Budget Code are intended to ensure that public funds are used in a targeted and economical manner.

The necessary national monitoring of financial impact measures in general consists of three steps: control of the achievement of objectives, impact and cost-effectiveness. A comparison of the objectives initially planned with the actual achievement of the target is used to determine the degree of achievement of the objectives at the time of the monitoring. By means of an impact check, it is determined whether the measure was appropriate and causal for achieving the objective. Finally, the performance check examines whether the implementation of the measure was economic in

terms of resource use and whether the measure was economic in relation to the main objectives as a whole.

Against the background of methodological comparability of performance checks,[8] a guidance document was[9] drawn up on behalf of the BMWi, building on previous evaluation experiences, which lays down methodological requirements at different levels and allows the BMWi and its downstream bodies to comply consistently with existing reporting obligations.

On the basis of this guidance document, the BMWi initiated an accompanying scientific evaluation of the current Directive on the Federal Promotion for Energy Efficiency in the Economy. Its aim is to contribute to the monitoring of achievements and to provide guidance on the further development of the programme. The evaluation of the EWW, including specific guiding questions from the BMWi, is carried out for the sub-programmes within the funding programme and is carried out in conjunction with the implementation of the programme ex-post and on an annual basis.

The evaluation includes data along 94 (sub-) indicators. They concern six sub-areas:

- **General indicators:** The general indicators cover structural data on support, figures on the take-up and distribution of support among sub-groups, for example by region, enterprise group, economic sector or application basis.
- **Indicators of the achievement of objectives**: These indicators shall include, in particular, information on reductions in energy consumption, emissions and energy costs.
- **Impact monitoring indicators**: Impact control indicators relate to correcting the indicators for distortive effects.
- **Performance control indicators**: The performance control indicators shall relate the results of the target achievement check to the expenditure incurred in implementing the programme.
- **Indicators of the process**: The indicators of the process relate to the perception and implementation of the programme.
- **Additional intelligence interests**: This sub-area raises specific issues for certain aspects of support.

With this continuous evaluation, a comprehensive assessment of the effects of the Funding Guidelines is therefore already carried out at national level using a large number of indicators. In order to ensure that the funding programmes are implemented in the most economical and economical way, the aim is therefore to link as far as possible questions which are relevant to the evaluation plan submitted here to direct (partial) results of the existing evaluation. Additional analyses will be carried out where specific questions in this evaluation plan make it necessary.

3 Evaluation questions

The evaluation questions determine the scope and focus of the evaluation. They should be answered quantitatively and, as far as possible, allow direct proof of effect (actualness). The three different levels of direct and indirect effects and appropriateness should be addressed.

State aid is generally ascribed to **direct** effects on both the aid-receiving and **indirect** effects, for example through spillover and crowding-out effects on third parties. The following shall apply:

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[8] https://www.bmwi.de/Redaktion/DE/Publikationen/Studien/evaluierung-und-weiterentwicklung-des-energieeffizienzfonds.html

[9] https://www.bmwi.de/Redaktion/DE/Downloads/M-O/methodik-leitfaden-fuer-evaluationen-von-energieeffizienzmassnamen.pdf?__blob=publicationFile

- In so far as the direct effects of State aid are very small or non-existent, the aid is considered to be very unlikely to be effective, unless there are convincing arguments in terms of relevant indirect effects.
- Positive direct effects may also be superimposed or covered by negative indirect effects.
- Direct and indirect effects may be in an immediate relationship of effect.

Accordingly, an evaluation should in principle also take into account indirect effects, but the assessment of direct effects according to the common methodology is considered to be easier to implement, whereas an analysis of indirect effects requires other, more case-related, methods than the assessment of direct effects.

The assessment will be based on questions on the direct effects of the aid, on the indirect effects of the aid and on the proportionality of the aid.

3.1 Direct effects

In accordance with the impact model described above, the direct effectsFigure4are attributed to the supported target group (aid recipients). As a first step, it should be analysed whether the support has been able to activate its mechanism of action by incentivising and implementing investment activities in the target group (incentive effect). Therefore, in relation to the output dimension of the impact model, the following questions should be asked:

1. To what extent has the aid concretely demonstrated the expected impact (incentivising the implementation of efficiency measures)?

2. Has the aid had a significant impact on the behaviour of the aid recipients (implemented efficiency measures, induced investments)?

In this context, it should be analysed whether the incentive or behavioural change has proved successful in line with the operational objectives of "technology openness", "cross-sectoral" (differences in incentive effect). The question must therefore be asked:

3. Did the aid affect the recipients of the aid in different ways?

   a. Have projects been carried out in all enterprise size classes relevant to the Funding Guidelines? Has the aid made it possible to address companies from all sizes in the same way?

   b. Have projects been carried out in all technology fields relevant to the funding guidelines?

   c. Has the aid resulted in the targeting of companies from all relevant sectors in the same way?

The outputs are the outcome of the support. These are in line with the main objectives of the support. It is necessary to analyse the results of the aid recipients as a direct funding effect (expected effects). With regard to the Outcome dimension, the following question should therefore be asked:

4. To what extent has the aid had the effects expected?

   a. Has the aid resulted in aided undertakings reducing their final energy consumption to a greater extent than non-assisted enterprises by implementing the investment projects?

   b. Has the aid resulted in aided undertakings reducing their primary energy consumption to a greater extent than non-assisted undertakings by implementing the investment projects?

c. Has the aid resulted in aided companies reducing their specific greenhouse gas emissions to a greater extent than non-assisted enterprises through the implementation of the investment projects?

d. Has the aid resulted in aided enterprises reducing their specific resource consumption to a greater extent than non-assisted enterprises by implementing the investment projects?

3.2 Indirect effects

The indirect effects are understood as the overall (general/economic) effects of the (collective) behavioural change and activities in the individual recipients of the aid. They are positioned in the impact dimension in the impact model. From the point of view of the target system, the focus here is on the contributions to the achievement of the policy objectives (mission in the target system), in which the Funding Guidelines are embedded. It is therefore necessary to ask:

5. Has the scheme contributed to the relevant policy objective?

   a. Have GHG emissions been reduced in line with quantitative targets?

   b. Has the final energy consumption been reduced according to the quantitative targets?

   c. Has the share of renewable energy been increased?

3.3 Proportionality and appropriateness

The proportionality and appropriateness of an intervention is determined by whether the intervention (or its underlying regime) can solve the problem to be dealt with efficiently and effectively, while avoiding potentially undesirable effects. The Funding Guidelines therefore focus on whether the incentive for investment activities and the savings achieved can also be achieved in other ways or better. Evaluation questions are therefore:

6. Have the different funding needs of the target group been sufficiently taken into account?

7. Was the most effective aid instrument chosen?

   a. Would the same effects have been achieved with less aid?

   b. Could the same effects have been achieved with a different form of aid?

4   Result indicators

The indicators Table3 listed in are intended to collect quantitatively information on the direct and indirect effects of the support programme and thus to answer the evaluation questions. A matching or difference-of -difference approach is applied by means of a control group to determine most of the indicators (see Chapter 5and Technical Annex for description of the method). According to current information, the control groups can only be used for modules 1 and 3, as a sufficient number of observations for sufficiently homogeneous measures in treatment and control groups are required for the application of the planned static econometric evaluation methods.

Table3:   Overview of key questions and indicators of the evaluation

Serial No		Key question of the evaluation	Indicator	Data source
1		To what extent has the aid concretely demonstrated the expected impact (incentivising the implementation of efficiency measures)?	[Target] Number of authorisations	Data from the national evaluation
2		Has the aid had a significant impact on the behaviour of the aid recipients (implemented efficiency measures, induced investments)?	Amount of investments or number of measures in the supported enterprises	Data from the national evaluation
			Amount of investments or number of measures in non-assisted enterprises	Separate survey of a control group, expert interviews where appropriate
3		Did the aid affect the recipients of the aid in different ways?		
	3a	Have projects been carried out in all enterprise size classes relevant to the Funding Guidelines? Has the aid made it possible to address companies from all sizes in the same way?	Distribution of authorisations by enterprise size class	Data from the national evaluation
			Distribution of authorisations by enterprise size class in relation to the relative number of holdings	Data from the national evaluation
	3b	Have projects been carried out in all (eligible) technology fields relevant to the Funding Guidelines?	Distribution of authorisations between technology fields	Data from the national evaluation
	3c	Have projects been carried out in all sectors relevant to the funding guidelines? Has the aid made it possible to address companies from all sectors in the same way?	Distribution of authorisations by sector	Data from the national evaluation
			Distribution of authorisations by sector in relation to the relative number of holdings	Data from the national evaluation

4		To what extent has the aid had the effects expected?		
	4a	Has the aid resulted in aided undertakings reducing their final energy consumption to a greater extent than non-assisted enterprises by implementing the investmentprojects?	Reduction of final energy consumption of encouraged	Data from the national evaluation
			Reduction of final energy consumption for non-supported persons	Separate survey of a control group, expert interviews where appropriate
	4b	Has the aid resulted in aided undertakings reducing their primary energy consumption to a greater extent than non-assisted undertakings by implementing the investment projects?	Reduction of primary energy consumption of promoted persons	Data from the national evaluation
			Reduction of primary energy consumption of non-supported persons	Separate survey of a control group, expert interviews where appropriate
	4c	Has the aid resulted in aided companies reducing their specific greenhouse gas emissions to a greater extent than non-assisted enterprises through the implementation of the investmentprojects?	CO_2 emissions reductions achieved by the supported	Data from the national evaluation
			Achieved CO_2 emission reductions for non-supported persons	Separate survey of a control group, expert interviews where appropriate
	4d	Has the aid resulted in aided enterprises reducing their specific resource consumption to a greater extent than non-assisted enterprises by implementing the investment projects?	Reduction of resource use among beneficiaries	Data from the national evaluation
			Reducing the use of resources by non-supported persons	Separate survey of a control group, expert interviews where appropriate
5		Has the scheme contributed to the relevant policy objective?		
	5a	Have GHG emissions been reduced in line with quantitative targets?	[Target] CO2 emission reductions achieved	Data from the national evaluation
	5b	Has the final energy consumption been reduced according to the quantitative targets?	[Target] Reduction in final energy consumption	Data from the national evaluation
	5c	Has the share of renewable energy been increased?	Increase the share of renewable energy	Data from the national evaluation

| 6		Was the aid scheme proportionate to the problem being addressed? Have the different funding needs of the target group been sufficiently taken into account?	Distribution under GBER vs De Minimis Loan vs. grant, differentiated according to sector and size class	Data from the national evaluation
7		Was the most effective aid instrument chosen?		
	7a	Would the same effects have been achieved with less aid?	End-use energy promotion efficiency, compared to other programmes	Data from the national evaluation, other evaluations
			GHG promotion efficiency compared to other programmes	Data from the national evaluation, other evaluations
	7b	Could the same effects have been obtained with less aid or a different form of aid? (For example, loans instead of grants)	Promotion efficiencies by loan/grant, de Minimis/GBER within the different programme variants	Data from the national evaluation

5 Methods

Various evaluation methods are proposed in the 'European Commission working documents on the common methodology for State aid evaluation'. Its purpose is to demonstrate a causal link between a State intervention and a change in the outcome of the undertakings subject to the intervention — in this case funding under the Guidelines on the Federal Promotion for Energy and Resource Efficiency in the Economy — Grant and Credit'. The basic problem of providing this proof is that undertakings cannot at the same time be subject to State intervention and cannot be subject to State intervention at the same time. It is therefore appropriate to consider a so-called counterfactual situation which makes it possible to conclude which outcome would have come about had they not been subject to State intervention. A strategy to create such a situation is that of the group of companies subject to intervention ("Treatment" group) — in this case: Receiving aid — a control group ("non-treatment" group). Information on the outcome of the control group can then, under certain assumptions, give a causal indication of the effect of the State intervention (so-called identification).

The ideally typical establishment of a control group is in reality an ambitious exercise. The European Commission's working documents therefore describe best practices and statistical methods as a guide (Figure5). Ideally, as part of a random experiment, a control group is formed by random selection from among those eligible for the application. Apart from treatment, differences between treatment and control groups are then purely random and differences in the outcome can be attributed to the intervention causally. In this case, the aid effect can be estimated (quantified) by comparing the averages and by appropriate static tests for statistical significance. In addition, other variables (e.g. structural characteristics of enterprises) that are correlated with the outcome variables can be taken into account through regression models. This makes it possible to estimate the aid effect more precisely. Since such a random experiment is usually not feasible in practice, other methods need to be used. These are based on quasi-experiments which are evaluated using appropriate econometric methods to estimate the impact of the aid in a causal manner. This usually involves identifying assumptions which, although questioned for plausibility, cannot always be tested statistically.

Figure5:　　　　**Overview of methods for establishing control groups**
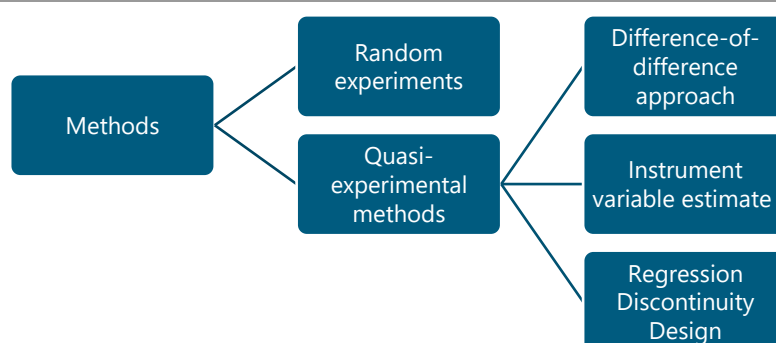
A particular problem in the evaluation of programmes with the voluntary participation of the Treatment Group is the distortion of the estimation of programme impact through selection bias (self-selection). This bias occurs when unobservable sizes (e.g. motivation/engagement of staff) are correlated with both programme participation and outcome. For example, it is precisely those companies that per se belonged to a group of companies that are particularly active in the field of energy

efficiency and resource saving that could be subject to State intervention — i.e. benefiting from the support. In this case, an estimation approach that does not take into account the bias in selection would overestimate the effectiveness of the intervention.

The technical annex to the working documents of the European Commission indicates that the application of the methods should be considered in the overall context of the action and in the light of the available data. The Funding Guidelines are characterised by technology-specific and partly technology-open solutions for technical systems. As a result, heterogeneous solutions are also used within individual modules of the Directive. On the one hand, these are improvements to individual technical aggregates (e.g. pumps) and, on the other hand, individual technical system solutions (e.g. production facilities). The savings achieved in each case vary significantly in relative and absolute terms depending on the type and implementation of the measure and the undertaking concerned. The implementation of outcome and impact is not immediate, but takes effect in the short term (e.g. component exchange) or only in the long term (e.g. transformation concept), depending on specific circumstances. Furthermore, the eligibility criteria differ in terms of their impact models. A first group includes changes to technical installations that have a direct impact on energy and resource consumption (e.g. more energy efficient compressor compared to the old installation). A second group concerns changes to technical installations that have only an indirect influence on consumption, for example by creating the conditions for analysing energy and resource consumption (e.g. installation of energy sensors). A third group includes non-technical measures aimed at the skills of staff (e.g. training in the use of energy management software). A fourth group deals with long-term decisions to decarbonise companies (e.g. transformation concepts).

A detailed assessment of the proposed methods carried out against this background can be found in Annex A. With regard to the methods proposed above, the following assessments can be summarised:

Random experiments as a statistical ideal of the evaluation do not apply to the funding guidelines considered here as a variant of proof of effect because of the necessary, but not met, conditions. One of the obstacles to their use is the fact that the support programme is already established on the market, that favouring randomly chosen undertakings is contrary to the principle of equal treatment and economic use of funds, and that there must be a need and interest in the support programme for the selected companies at all.

Regression **Discontinuity Design** as a quasi-experimental method requires the availability of a variable that decides exogenously on programme participation. An exogenous variation in the probability of belonging to the treatment group is not obvious for the funding guidelines under consideration here. For example, there is no corresponding geographical variable (e.g. support in Land A, but not in Land B), as this is a nationwide programme. Similarly, there are no equivalent alternatives to geographical demarcations by restricting the programme to certain groups excluded from participation in the support programme, since, on the one hand, the eligibility of the programme for applications is broad and, on the other hand, where certain groups (e.g. by sector) are delimited, certain technological solutions may still be available in only one of the two groups, thus eliminating the direct possibility of comparison.

A pre- **requisite** for instrument variable estimation is the existence of an instrument variable that has a strong correlation with treatment but must not be correlated with the outcome and not with the error term. No such variable is currently available.

The **difference-of-difference method** is, among the methods proposed, the most suitable method in your circumstances for evaluating a programme such as the funding guidelines under

consideration, provided that the outcome variable can be reasonably measured over time (e.g. energy consumption). For practical reasons, however, it may be useful to use the implementation of a given measure per se as an outcome variable. In such cases, **matching procedures** may also be appropriate for the evaluation of that directive, provided that the (non-testable) assumption of conditional independence is plausible. This is best ensured by collecting information for treatment and control groups on as far as possible all relevant variables affecting both treatment and outcome. If a variable can be found but treatment does not influence the outcome, a Heckman selection model may also be used to take into account selection bias. Depending on the output variable and data availability, it may also be useful to combine matching and difference-of-difference methods for the evaluation of certain measures.

With a view to forming a control group, a number of practical challenges need to be taken into account. Given the technological differences in funding, this includes the choice of appropriate survey dates, which may vary according to the eligibility criteria. It is also essential for the selection of the control group that it is possible to collect reliable information which, first, allows for matching and, secondly, a comprehensible identification of the outcome. The latter is particularly demanding because, as mentioned above, the programme allows for very individual technical solutions (one-of-a-kind), particularly in the systemic funding areas. A nuanced assessment of the individual solution is therefore necessary; the use of collected statistical, administrative or fiscal information hardly takes this into account.

In principle, the use of matching or difference-of-difference methods makes sense only where there is a sufficiently large sample to allow a meaningful statistical econometric estimation. A sufficient number of funding cases are currently available only for modules 1, 3 and 4. Module 4 is characterised by a very high degree of technological heterogeneity, so the identification of similar undertakings with comparable technological activities seems practically impossible. Matching is therefore Table3 sought for modules 1 and 3 and result indicators 2, 4a, 4b, 4c and 4d in accordance with the difference-of-difference method (if applicable).

On account of the above-mentioned limitations, a fallback option is also provided for in so far as the practical implementation of the evaluation shows that no meaningful statements can be made.

For the remaining modules and transformation concepts, it is envisaged to use a combination of expert discussions and a survey of those receiving the aid. The purpose of these interviews and interviews is to obtain triangulation of the causality of the effects of the measures through multi-level questions. This approach is also considered as a fall-back option, where the intended implementation of the difference-of-difference method should prove to be unfeasible.

The indicators, which are collected in the same form in the national evaluation (result indicators 1, 3a, 3b, 3c, 5a, 5b, 5c and 6), are fed from the results of the national evaluation, which [10] follows the BMWi Methodological Guide for Energy Efficiency Evaluations. There is a particular need for further development for the use of renewable energy, as it has not yet been covered (result indicator 5c). In addition to the existing evaluation, the aim is to draw conclusions on the effectiveness of the instrument on the basis of a comparison of the results of the various programme variants of the 'Bundesförderung für Energie- und Resource Efficiency in the Economy' (credit/grant and accompanying promotional competition), using further evaluations and the findings on the other result indicators (result indicators 7a and 7b).

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[10] https://www.bmwi.de/Redaktion/DE/Downloads/M-O/methodik-leitfaden-fuer-evaluationen-von-energieeffizienzmassnamen.pdf?__blob=publicationFile

6   Data collection

The data sources envisaged for the implementation of the evaluation plan are set out below:

As explained above, the funding guidelines under consideration here are a diverse, technology-oriented programme to improve energy and resource efficiency. The use of reference values for market shares of the various energy and resource efficient technologies could in principle be envisaged, but there are no sources from which such statistical data would be available. In addition, they could only be used in a complementary way to the evaluation methods proposed above, as the latter are based, for methodological reasons, on individual observations from enterprises and not on statistical aggregates. Accordingly, extensive use must be made of information from the support programme itself or of further surveys.

In addition to contact information, additional information is collected from the applicant companies at the time of the application, which is partly relevant for analysing the impact of the programme along the above-mentioned indicators or for the accompanying national monitoring of the programme, including information on the sector, number of employees, number of employees and balance sheet, type of company, etc. Additional technical and company-specific information will be collected depending on the module. This data is collected individually by the institutions/promoters involved in the application and is mostly available in the form of databases. Current efforts are aimed at converting non-machine-processable data from remaining paper-based documents into directly processable electronic formats. In addition, the applicants agree to participate in the evaluation of the funding programmes with the application. For the national evaluation of the funding guidelines in force so far, regular annual surveys of applicants are carried out for the purpose of collecting data. More specifically, all applicants who have received a commitment for the relevant application period (calendar year) will be contacted and invited to the interview. The online survey includes detailed questions and includes module- and type-specific and cross-cutting, common questions. For cross-company information (e.g. primary energy factors), standard values from the Methodological Guide for Evaluations of the BMWi continue to be used.[11]

The current data collection should be extended to include additional information for the indicators on resource efficiency and renewable energy use. This concerns in particular the submission of the application and the interview. For comparison with other programmes, it is also necessary to use information on other evaluated programmes in the field of energy efficiency. On the one hand, older programmes of the BMWi in the field of energy efficiency are sometimes used here, as well as other national programmes, as well as international data (e.g. evaluation studies of other countries, scientific publications, etc.).

In addition, the evaluation using the matching method and, where appropriate, the difference-of-difference method requires additional data collection with a sufficiently large sample of companies to allow conclusions to be drawn on outcome variables in an appropriate control group. According to current information, for statistically usable results, the aim is to carry out a quota-based survey of approximately 1000 companies in the control group if a matching procedure is used. Depending on the specific design, module-specific control groups may also need to be used, which will depend on the treatment group in question. The quotas to be set are in principle based on the characteristics of the treatment group and may, for example, comply with requirements on sectors, company

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[11] Other sources of information are also used in the national evaluation, but these are not directly used for the result indicators used here. This includes telephone conversations with the participating funding institutions and energy consultants on programme management. In the case of support under Module 4, a savings plan (e.g. on location, actual state, target state, energy consumption and system benefits, investments) must also be submitted, to be produced by an approved energy consultant.

sizes or energy consumption. The information to be collected is currently based on the measures in Modules 1 and 3 and continues to include various structural features, as well as information that influences the outcome and treatment. In addition to the quota-relevant information, it is envisaged, among other things, to collect characteristics on energy consumption and energy expenditure — differentiated by energy source where necessary — on the state of implementation of energy efficiency measures and on specific changes in energy costs/consumptions resulting from energy efficiency measures. In order to take into account the difference-of-differentiation approach, it is also foreseen to cover these changes for several dates as necessary or by specifying changes in time. A definition of specific characteristics will be made in the development of the fine-tuning concept during the implementation of the evaluation.

Where expert discussions are used, the aim is to organise interviews with approximately 5-10 representatives from different target groups. In addition to business representatives, the target group -includes energy consultants, contractors, academics, project promoters/applicants and banks involved. The experts selected must meet certain criteria. These include, inter alia, relevant background knowledge in the field of energy and resource efficiency, knowledge and preferably experience in the use of public support programmes, experience in monitoring applications under the Directive and/or knowledge of practical evaluations in the relevant subject area. According to current planning, the interviews are to be carried out as semi-structured in-depth interviews with a planned scope of up to one hour. The content is chosen on the basis of the expert's role or the focus of the modules. If the results of the discussions give rise to in-depth exchanges, further technical discussions are planned. Here too, this provisional design will be further developed and made more specific in the context of the evaluation.

7   Timing of the evaluation

The current lifetimes of the General Block Exemption Regulation and the Funding Guidelines provide key elements for the implementation of the evaluation. As the AVGO was originally due to expire on 31 December 2020, it was initially extended until 31 December 2023. It is therefore limited in time to 30 June 2024, with reference to an adjustment period of 6 months; in the event of an extension of the GBER, the Directive will be extended until 31/12/2026. In accordance with the Commission's guidance document, the evaluation reports will be submitted six months before the expiry of the aid scheme/aid guidelines. Against this background and in view of the ongoing annual national evaluations, the evaluation of the aid scheme is to be carried out in two stages. A first interim evaluation report shall be submitted no later than 31/12/2023, i.e. six months before the end of the Directive. A longer lead time for determining the status quo in the control group is needed to carry out the control group analysis using the matching/difference method. It is therefore planned to start the work of the Evaluation Panel on 1 September 2022.

A second evaluation report — subject to an extension of the aid scheme beyond 30 June 2024 — will be submitted as a final evaluation report six months before the expiry of the current guidelines, i.e. no later than 30 June 2026. The work of the evaluation panel is then scheduled to begin with 15 months in advance of 1 April 2025.

8   Independence and expertise of the Evaluation Panel

This evaluation is carried out by an independent and competent evaluation body on the basis of the principles set out in this evaluation plan. Due to the time horizon, no evaluation panel has yet been established at the time of reporting. However, experts from the ongoing evaluation (see section2.7) of the "Bundesförderung für Energie- und Resource Efficiency in the Economy" were involved in the drafting process of this document in order to take into account practical experience from the already existing evaluation.

Ensuring independence

The evaluation panel shall be considered independent if it has no conflict of interest in the context of the evaluation and is independent of the BMWi and the institutions directly involved in the resolution within the framework of this evaluation plan and its conclusions. In this case, the latter are the Federal Office for Economic Affairs and Export Control (BAFA), including the Federal Energy Efficiency Agency (BfEE), the Kreditanstalt für Wiederaufbau (KfW) and VDI/VDE Innovation + Technik GmbH. To this end, the Evaluation Body will be granted access to all data and information necessary for the evaluation in a timely manner. In addition to the data on the enterprises supported as such, this also includes other information as needed.

In order to ensure the independence of the panel, provision is made for a contract to be awarded to one or more external, independent service providers. This award should comply with the requirements of German public procurement law and be carried out in competition (EU-wide tender) as a tendering procedure on the basis of transparent, pre-defined selection criteria, using a detailed evaluation grid attached to the tender documents. The call for tenders incorporates the present evaluation plan. The selection criteria are defined on a factual basis in order to exclude a non-objective selection of the panel. Furthermore, the contractual documents include a mandatory declaration by the tenderer(s) that there are no conflicts of interest when carrying out the evaluation. Once the contract has been concluded, the successful tenderer(s) will act as an evaluation panel independent of the above-mentioned institutions. This ensures the technical and substantive independence of the evaluation panel. In order to ensure a complete report, the BMWi and the contracting institutions examine the content of the evaluation panel's reports for completeness and, if necessary, issue additional requests.

Determination of expertise

An important part of the selection criteria is the expertise of the Evaluation Panel in terms of qualifications, experience and competences of its members. These must be demonstrated in each case.

The qualification of the panel is based on the sum of the training provided by its members, who, taken as a whole, must possess the necessary technical, economic, social and methodological expertise in order to be able to understand the implementation of the support programme both within the institutions involved in the implementation of the programme and among the beneficiaries. Relevant publications on evaluations in areas relevant to the funding guidelines are also included in the definition of qualifications. Furthermore, knowledge of the methodological procedures for evaluating BMWi funding programmes in the field of energy efficiency in the form of the Methodological Guide of the Energy Efficiency Fund, as well as the ability to follow up on the results of the ongoing national evaluation of the support programme, are crucial.

Experience is measured on the basis of the number and scope of previous evaluations of public support instruments carried out. These evaluations must be directly linked to the thematic priorities of the Funding Guidelines, i.e. they must be attributable to energy and resource efficiency in companies.

The competences are based on the quality of the operationalised evaluation concept. This includes the clarity, comprehensibility, comprehensibility and consistency of the overall approach, the appropriateness of the tools, methods and model chosen for the implementation of the evaluation, the follow-up of the requirements set out in this document and a robust and comprehensible management of the implementation, including appropriate time and planning.

Description of the necessary resources

In order to carry out the evaluation, the aim is to have a close link with the national evaluation of the 'Bundesförderung für Energie- und Resource Efficiency in the Economy' (Bundesförderung für Energie- und Resource Efficiency in the Economy) which has already been carried out. Adequate resource needs are estimated, building on the experience of national evaluations. It is assumed that the evaluation panel consists of 3 to 4 persons; additional competent persons may be involved for part-time work.

9 Publication of evaluation results

After acceptance, the evaluation plan and the evaluation results will be published on the BMWi website, probably in the field[12]of evaluation. The aim of the BMWi is therefore already to present evaluations and the resulting findings in a transparent manner. Among other things, the evaluation results of previous and other programmes of the BMWi (Energy Efficiency Fund[13], STEP up![14]) and the basic methodological guide for evaluations of energy efficiency measures are[15] publicly available there. Personal or justified confidential data are not part of these results reports.

In addition to the publication of the results, the aim is to organise, at least once the results of the interim evaluations are available, an exchange with stakeholders in order to discuss the conclusions of the evaluation and the national evaluation. The purpose of this exchange is to present proposals for the further development of the Directive or for the operational implementation of the Directive. A group of 20 to 30 delegates from the following areas will be targeted: Funding provider, implementing institutions, evaluation experts and representatives of the beneficiaries.

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[12] https://www.bmwi.de/Navigation/DE/Service/Evaluationen/evaluationen.html

[13] https://www.bmwi.de/Redaktion/DE/Publikationen/Studien/evaluierung-und-weiterentwicklung-des-energieeffizienzfonds.html

[14] https://www.bmwi.de/Redaktion/DE/Evaluationen/Foerdermassnahmen/pilotprogramm-stromeinsparungen-im-rahmen-wettbewerblicher-ausschreibungen-stromeffizienzpotentiale-nutzen-step-up.pdf?__blob=publicationFile&v=8

[15] https://www.bmwi.de/Redaktion/DE/Downloads/M-O/methodik-leitfaden-fuer-evaluationen-von-energieeffizienzmassnamen.pdf?__blob=publicationFile

10 Technical Annex A: Balancing of methods

This technical annex briefly summarises the methods proposed in the guidance document and assesses them with a view to their transferability to the evaluation of the guidelines on "Federal support for energy and resource efficiency in the economy — grant and credit". To this end, the methodological conditions and the data necessary for the application of the methods are presented first with a view to the evaluation of the Directive. This follows an examination of the practical transferability of the methods for evaluating the Directive in order to determine the extent to which the relevant conditions are met or the limits to which the methods are subject in the practical evaluation. Finally, a conclusion is drawn on the application of the methods in the context of an evaluation of the Directive.

10.1 Experimental methods: Random experiments

Description of the approach

The basic idea of the random experiment is to select entirely randomly the aid recipients and the control group. This means that self-selection and other selection-related differences can be completely avoided. The random experiment guarantees that the group of companies that have not received aid is determined exogenously. Differences in the outcome between treatment and control groups can be attributed to the existence of the aid. Figure6illustrates the basic principle of random experiment: The population is the totality of all eligible enterprises. From the population, companies are randomly selected and thus subject to State intervention and those entering the control group.

Figure6: **Illustration of the random experiment**
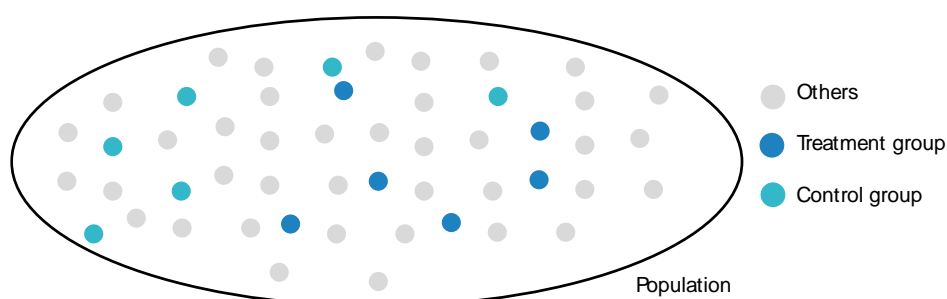
Conditions for the methodological approach

- **Need for intervention**: A key condition for a random selection of the beneficiary is that the selected beneficiary is in need of intervention at the time of the selection. It is precisely in the case of technology-oriented programmes that there will be no demand for a new technological installation at any time due to the integration of reinvestment cycles.
- **Enterprise as an individual**: The procedure presupposes that the undertakings can be approached as individuals. However, a random approach to a company does not ensure that information on the participation of relevant actors in the company is actually received. This can favour the selection of companies that have better internal communication processes per se.
- **Date of intervention upstream**: It must be ensured that sufficient time is allocated to implement the subject of the intervention (e.g. procurement, delivery and installation of a system). It is therefore first necessary to ensure that the persons receiving the aid are selected. It is

only if this group can be expected to have an effect through intervention that the survey can be carried out in the comparator group.

- **Outcome observable**: The outcome of the support must be identifiable at least at an ordinal level.

Requirements for the required data

- **Availability of a list:** A list of all companies must be available in order to distort selection through selective lists (for example, only medium-sized and large enterprises; listed companies) When sub-lists are used, a representative extract shall be ensured.
- **Availability of contact information**: Up-to-date contact information must be available on the randomly selected companies.
- **Availability of data:** The randomly selected enterprises (both aid-receiving and control groups) must in principle have information at the relevant point in time on the outputs, e.g. on energy consumption in the application fields concerned, and on other relevant variables.
- **Provision of data:** Companies must provide this data.

Considerations on the transferability of the methodology to the evaluation of the Directive

- The European Commission's methodology already points out that favouring a random beneficiary **runs counter to the principle of selecting the most suitable beneficiaries**.
- It is only after it has been established that the evaluated funding guidelines exceed the State aid thresholds and the previous guidelines **have already been established for some time on the market**. Accordingly, the maintenance of constant support lines in the outer space militates against a re-establishment or random distribution of funds. The situation of a pilot programme referred to in the methodological guidelines is therefore not present for the evaluated Directive.
- In the event of a random award of State funding, **compliance with the principle of equal treatment would be called into question**. This is also the case where parts of the Funding Guidelines are subject to targeted testing and beneficiaries are randomly selected for these modified variants. However, account should be taken of the additional administrative burden involved in the preparation, implementation and follow-up of variant funding.
- Furthermore, the need for intervention is not mandatory, i.e. undertakings may refuse to benefit from support. As a result, **self-selection may still be linked to the acceptance of the support**.

Conclusions for application in the context of the evaluation of the Directive

Due to the limitations on the transferability of the methodology described above, the use of experimental methods with random selection in accordance with the methodological guideline is considered incompatible and useful for the Funding Guidelines.

10.2 Quasi-experimental methods

In addition to random experiments as a methodological ideal, there are a number of quasi-experimental methods to measure the effects of public intervention. They aim at creating a situation close to an experimental situation, usually taking advantage of exogenous changes in the business environment. This ideally makes it possible to estimate the impact of public support in a non-distortive manner.

Selection model to Heckman

Self-selection leads to a so-called endogenicity problem, i.e. the error term of the estimation equation of the outgoing variables is an explanatory variable (here: Selection variable) correlates as there are unobservable variables correlated with both selection and outcome. Two equations are estimated to solve the problem, selection equation (i.e. participation in the funding programme) and outcome equation. For estimation practice, this means that there must be a variable correlated with participation in the funding, but not with the outcome. On the data side, it should be noted that the outcome variable exists only for companies which also participate in the support programme.

Matching method

In these procedures, enterprises in the control group are allocated to the treatment group using matching methods based on observable variables (e.g. structural characteristics). Matted enterprises should be as similar as possible to relevant sizes (see Figure 4). In the case of Propensity Score Matching (PSM), this is done through the predicted probability that a given company will benefit from support. Companies in the Treatment Group are matched with companies in the control group with similar propensity scores[16]. The effect of an aid can then be estimated by simply comparing the outcome variables of the Treatment Group with the control group of matted 'twins'.

Similarly to simple regression procedures (i.e. regression of outcome variables on treatment dummy and other covariants such as company structural features), matching methods are based on the assumption of conditional independence. In other words, after taking into account the influence of the covariates (or characteristics) on the outcome, State intervention remains the only factor that explains the impact. Ideally, therefore, all variables that influence both the outcome and the choice should be taken into account. In practice, matching procedures are therefore not suitable to prevent possible distortion of selection. Compared to regression, the advantage of matching is that they are based on less restrictive assumptions.

Figure7:   Illustrative examples of pair assignments.

Matching pair

Treatment group   Control group
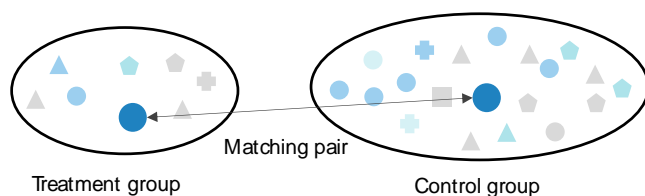
10.2.1 Quasi-experimental methods: Difference-of-difference approach

Description of the approach

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[16] It is de facto impossible to match exactly companies (e.g.: Turnover and number of staff).

The basic concept of the difference-of-difference approach is based on a comparison of the evolution over time of the outcome between treatment and an appropriate control group before and after the time of intervention. The impact of the aid can be estimated under the identifying assumption that the outflow of the control group reflects the time path that would have been observed in the treatment group for the outcome. It is irrelevant whether or not the outputs of the two groups have the same level prior to intervention (i.e. a possible distortion of selection is neutralised). This means that the difference in outcomes between treatment and control remains constant during the relevant period.

The difference-of-difference approach can be combined with the matching method described above. Alternatively, the difference-of-difference approach can be estimated using a regression model. If observations are available for more than two periods, account may be taken of firm-specific effects (e.g. sector-specificity) and temporal trends affecting treatment and control groups alike (cyclicality).

The problem of unobserved variables is ultimately excluded in this procedure by assuming that these unobserved variables are of the same nature or constant over time for the enterprises considered. If observations from the outcome variables for treatment and control groups are available for the pre-intervention period, the plausibility of the identifying assumption (parallel trends) can be checked (graphically). Where available, several control groups may also be used in parallel in extended variants of the method.

Figure8: **Illustration of the difference-on-difference approach: Differences in outcome over time.**
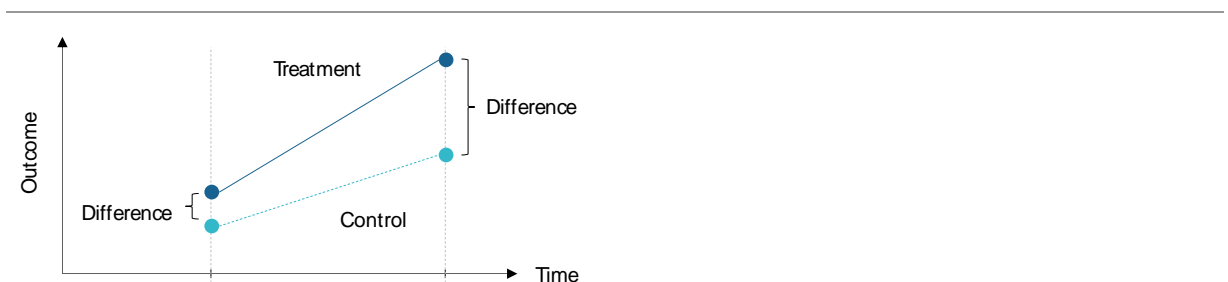
Conditions for the methodological approach

- **Identical response of companies**: The control group must be chosen in such a way that it reacts identically to external changes and developments throughout the period under consideration.
- **Exact date**: It must be possible to determine reasonable times 'before' and, in particular, 'after' the intervention.

Requirements for the necessary data

- **Availability of contact information**: Contact information is available for the companies in the control group.
- **Availability of selection data**: Data for the selection of businesses, i.e. for identifying suitable pairs, are available for both groups, in particular for companies in the control group.
- **Outcome observable**: The output can be described by means of a variable and the value of this variable can be recorded.
- **Availability of several data points**: The data on the outcome are available for both pre-intervention dates — i.e. the granting of the aid — and subsequent dates. The corresponding data are also available for the pairs of enterprises for identical dates.
- **Provision of data**: Companies of both groups, in particular the control group, shall provide this information.

- **Plausibility check** (where applicable): Selection and performance data available for additional earlier dates.
- **Several control groups** (where applicable): Additional information is available from operators from other control groups.

Considerations on the transferability of the methodology to the evaluation of the Directive

- Under the funding guidelines considered here, a technology support programme supports **very heterogeneous** funding schemes which are not directly reflected in cross-company outcome sizes. This is due, on the one hand, to **the fact that parts of the supported measures have only a supporting character** (e.g. measurement technology). On the other hand, changes can be expected to be covered as outcome sizes, e.g. by saving smaller interventions by other fluctuations in the energy consumption of entire companies. Therefore**, it is not possible** to define **overall outcome sizes without taking into account technical circumstances**. In addition, the number of enterprises in the respective sub-groups decreases, which may reduce the statistical validity of the evaluation.
- A contrario, this means that **a differentiated view of outcome sizes would be necessary**. Accordingly, the companies in the control group would have to collect the relevant information at a detailed technical level. **Statistical, administrative or fiscal data directly related to such content are not available**.
- This raises the question of the availability of such data. In previous work in the national evaluation of the "Bundesförderung für Energie- und Resource Efficiency in the Economy" (Bundesförderung für Energie- und Resource Efficiency in the Economy), for example, feedback rates have been reached between 10 % and 30 % depending on the module, although beneficiaries agree in principle to participate in the evaluation when the funding is completed. It is therefore foreseeable that the **motivation of a control group not linked to the support programme will be difficult**, in particular where data must be collected repeatedly for several times. In the past, in the field of energy efficiency, such data could be implemented in several projects, but only for individual issues, through coordinated and parallel data collections.

Conclusions for application in the context of the evaluation of the Directive

The application of the difference-of-difference approach does not seem appropriate within the scope of the Directive. It could in principle be used for sub-questions, but due to the complexity of data collection and methodological limitations, it could only be used for partial aspects.

10.2.2 Quasi-experimental methods: Instrument variable estimate

The objective of the instrument variable estimate is to avoid distortions resulting from the endogeneity of the use of support when analysing the impact of the programme. Similarly to selection bias, there could be unobservable variables correlated with both the take-up (or selection) and the outgoing variables. In economic terms, this problem can be solved by means of an instrument (or exclusion) variable. This shall be highly correlated with the selection variables, but shall not be correlated with the error term of the outcome regression equation. The first condition can be tested, the second condition cannot be tested.

Conditions for the methodological approach

- **Availability of an instrument variable:** In order to carry out the necessary analyses, the availability of an appropriate variable is required.

Requirements with regard to the necessary data:

- **Availability of two data points**: Data are available both before and after the granting of the aid or in cross-sectional form.

- **Provision of data**: Companies of both groups, in particular the control group, shall provide information.
- **Availability of performance data**: In principle, the recipients of the aid have this information on technical implementations and other relevant structural variables.
- **Provision of performance data**: The recipients of the aid shall provide this information.
- **Recognisable outcome**: The output can be described by means of a variable and the value of this variable can be recorded.

Considerations on the transferability of the methodology to the evaluation of the Directive

- The procedure is based on the fact that an instrument variable can be identified in accordance with the above requirements. Based on past data and experience, **such a variable is not known** and it is questionable whether such a variable can be identified.
- Given the different outcomes and heterogeneous technical options implemented under the Funding Guidelines**, it remains questionable whether such a variable can be identified across** the board.

Conclusions for application in the context of the evaluation of the Directive

As application of the methodology is questionable on the basis of the substantive framework conditions of the Funding Guidelines, this method is assessed as not promising in practice for a successful evaluation.

10.2.3   Quasi-experimental methods: Regression Discontinuity Design

The basic idea of regression Discontinuity Design is the use of a variable that has a discontinuous impact on the probability of participating in the programme. Such variables may be present, inter alia, by geographical differences or other conditions which are a condition for eligibility for support. By comparing the companies participating and those that do not (very) participate, it is possible to draw a conclusion on the effectiveness of the programme. Figure9illustrates the basic principle: The undertakings in the marked area are subject to support, but companies which are just outside the range are even more similar to those within the range, but they are more different as they are more distant.

Figure9:   **Illustration of Regression Discontinuity Design**
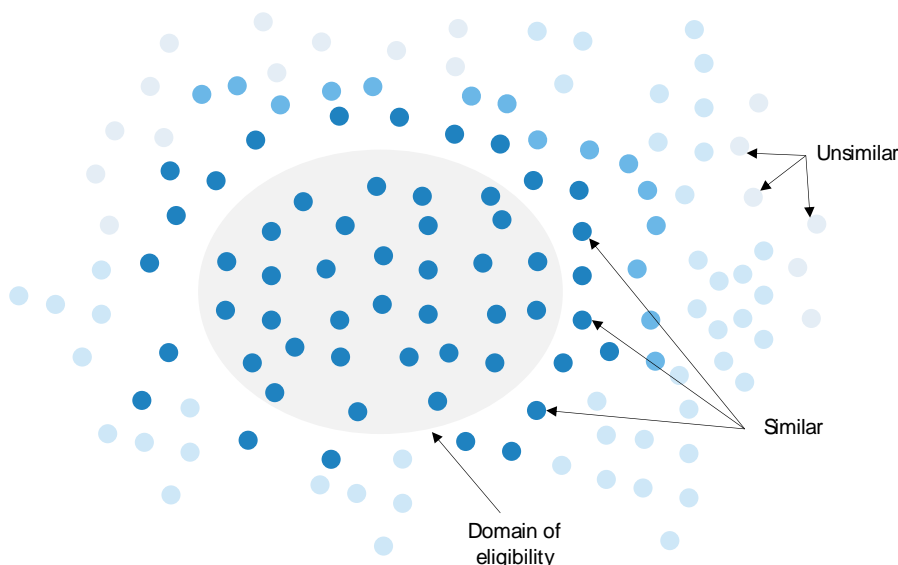
Methodological requirements:

- **Existence of a differential variable:** In order to apply the procedure, it is necessary to have a variable allowing a distinction to be made between supported and non-assisted enterprises (e.g. support limited to certain geographical regions; or depending on company characteristics such as turnover or number of employees).
- **Leap-free**: For formal reasons, the method assumes that all variables from the different variables are continuous variables, i.e. there are no further discontinuities related to the outcome.
- **Proximity to the threshold**: An appropriate threshold can be set as to when firms, a potential control group, can still be perceived as sufficiently 'close' to the group of subsidised companies.
- **Number of enterprises**: There must be a sufficient number of control group undertakings close to the threshold.

Requirements with regard to the necessary data:

- **Availability of the differential variables**: In addition to the existence of the variables, the value of the variables is generally known.
- **Selection of companies in the control group:** Information is available on which firms are close to the threshold and can therefore be used for the application of the method.
- **Contact details and contact person**: **Business contacts are available**for the collection of the data.
- **Availability of data**: In principle, this information on technical implementations and other relevant structural variables is available to enterprises and enterprises, in particular the control group, provide this information.
- **Outcome observable**: The output can be described by means of a variable and the value of this variable can be recorded.

Considerations on the transferability of the methodology to the evaluation of the Directive

- There **is no geographical exclusion in the Funding Guidelines**, as this is a nationwide programme; cross-border comparisons are problematic due to the different framework conditions.
- Other **variables of a similar nature are not known**, i.e. there are no variables that have an inconclusive impact on the probability of funding.
- The existence of such other variables (e.g. split between supported and non-supported sectors) would have to ensure that **the technical solutions implemented can nevertheless be fully mapped**, i.e. which does not exclude certain segments of the support (e.g. a sector-specific technology is found only in the sector under consideration, not outside).
- An **operationalisation of the 'distance' from the support programme is not trivial** because of the heterogeneity of funding.

Conclusions for application in the context of the evaluation of the Directive

In the absence of appropriate discontinuities, the methodology is not applicable.