Evaluation plan

for the

funding guideline for the

‘Investment programme for modernising production in the vehicle manufacturing and supply industry’
[2021 Funding Guideline]

Table of Contents

Introduction

The German Federal Ministry for Economic Affairs and Energy (BMWi), in light of EU provisions, and taking into account the best practices recalled in the Commission Staff Working Document on Common methodology for State aid evaluation, submits this evaluation plan for the investment programme 'Aid guidelines for the investment programme for the modernisation of production in the vehicle manufacturing and supply industry", hereinafter: "investment programme".
This evaluation plan will be the basis for the future evaluation conducted under State aid rules. The future evaluation will provide evidence on the direct impact of the aid on its beneficiaries, on its possible indirect impacts, on the proportionality, and on the appropriateness of the aid measure. The evaluation plan and the future evaluation will help to ensure that similar schemes will be more effective in the future and will create less distortion in markets (if any). The evaluation will also improve the efficiency of similar schemes and, possibly, of future rules for granting state aid in this area. BMWi already evaluates its subsidy measures, and is committed to evaluating relevant schemes on a regular basis.

The overall objective of this evaluation plan is to:

- prepare the assessment of effects of the scheme
- discuss the identification problem
- clarify the methods to be used
- outline the timeline, and
- describe the expected outputs

The future evaluation will help to explain whether and to what extent the original objectives of the investment programme were fulfilled and determine the impact of the scheme. The evaluation plans sets out the requirements that the future evaluation will have to seek to establish the causal impact (differences between the outcome with the aid and the outcome in the absence of aid) of the scheme. As required by Article 2(16) of the GBER and in line with best practices for State aid evaluation, the evaluation plan contains the description of the following main elements:

- the objectives of the investment programme to be evaluated,
- the evaluation questions,
- the result indicators,
- the envisaged methodology to conduct the evaluation,
- the data collection requirements,
- the proposed timing of the evaluation including the date of submission of the final evaluation report,
- the description of the criteria that will be used for the selection of the independent body conducting the evaluation and
- the modalities for ensuring the publicity of the evaluation.

The national legal basis of the scheme is the programme's funding guidelines "Förderrichtlinie Investitionsprogramm zur Modernisierung der Produktion in der Fahrzeughersteller- und Zulieferindustrie" (Aid guidelines for the investment programme for the modernisation of production in the vehicle manufacturing and supply industry"). The scheme is implemented by one project promoters, the Federal Office for Economic Affairs and Export Control (BAFA).

Brief description of the funding guideline to be evaluated

Concept and objectives

For the purposes of evaluating the funding measure, it is necessary to outline its objectives and underlying concept, so as to allow for the special features of the 'investment programme for modernising production in the vehicle manufacturing and supply industry' to be taken into account in the evaluation. In the following, the funding guideline will be referred to as the 'investment programme' for short.

Design of the investment programme

Under the Federal Government's Stimulus and Future Package[1], which is designed to combat the economic repercussions of the COVID-19 pandemic, a funding framework for 'forward-looking investments by vehicle manufacturers and their suppliers' (Stimulus and Future Package lit. 35c)[2] has been created, under which the funding guideline for the 'investment programme for modernising production in the vehicle manufacturing and supply industry' has been set up as a new funding measure which took effect at the end of March.[3]

The investment programme is designed to promote investments by companies within the vehicle industry (especially suppliers and SMEs) in new manufacturing equipment, industry-4.0-capable equipment, digitisation and environmental sustainability in the manufacturing process, and related investments in consultancy services and training measures.
The target group is commercial companies in the vehicle industry, especially small and medium-sized enterprises (SMEs), which are eligible to apply for funding under the programme. The vehicle industry within the meaning of the funding measure includes all types of terrestrial vehicles for civilian use, in particular cars, commercial vehicles and motorcycles, mobile work and agricultural machinery, railway vehicles, bicycles and e-bikes/pedelecs. In the following, the focus will be on the automotive, commercial vehicle and railway industries as these are the priority areas of the funding measure (without other modes of land transport being excluded, however). In addition, companies outside the vehicle industry are also eligible to apply if they can demonstrate that their product portfolio is closely linked to the vehicle and supplier industry. This is intended to cover the entire value networks of the vehicle industry.

Funding is provided for different funding areas depending on the type of project:

I. Investments in the expansion and optimisation of manufacturing facilities and processes (e.g. acquisition of machines and equipment including the software and hardware required for their operation)
II. Related investments for the development of corporate capabilities (e.g. through project-related consultancy services, staff training and adjustment measures)

Funding is provided either on the basis of the General Block Exemption Regulation (GBER) or on the basis of the 2020 Federal Framework 'Small amounts of compatible aid', as amended.[4] The basis for funding

1 https://www.bundesfinanzministerium.de/Content/DE/Standardartikel/Themen/Schlaglichter/Konjunkturpaket/2020-06-03-eckpunktepapier.pdf?__blob=publicationFile&v=12

2 For more information, visit www.kopa35c.de.

3 The funding guideline was published in the Federal Gazette on 26 March 2021, upon which act the funding measure entered into effect on the following day (Federal Gazette AT 26 March 2021 B4).

4 The current version of the 2020 Federal Framework "Small amounts of compatible aid" is the "Fourth Amended 2020 Federal Framework 'Small amounts of compatible aid'" issued by the Federal Ministry for Economic Affairs and Energy on 12 February 2021 (Federal Gazette AT 1 March 2021 B1).

(GBER or 2020 Federal Framework ‘Small amounts of compatible aid’) can be chosen by the applicant at the time of application. The maximum funding rates are based on the attribution of the eligible project expenses to the aid categories and aid intensities in accordance with Article 17, Article 18 or Article 38 GBER or on the basis of the limits defined by the funding guideline based on the 2020 Federal Framework ‘Small amounts of compatible aid’.

In the case of funding provided on the basis of the GBER, the aid intensity per recipient may not exceed the following rates:

I. Investments in the expansion and optimisation of manufacturing facilities and processes

a) Investments in innovative and digital production technologies based on Article 17 GBER:

- 20% of eligible expenses for small businesses
- 10% of eligible expenses for medium-sized businesses

b) Investments in technologies and processes to improve environmental sustainability, energy and resource efficiency, and circular economy based on Article 38 GBER:

- 30% of eligible (additional) expenses
- In addition, small and medium-sized enterprises can receive an additional bonus of 10 percentage points on eligible expenses.

II. Related investments for developing corporate capabilities based on Article 18 GBER:

- 50% of eligible expenses

As regards funding areas I) and II), the applicant may alternatively opt for funding based on the 2020 Federal Framework ‘Small amounts of compatible aid’ as described above. In this case, the maximum funding rates and maximum aid intensities defined in the funding guideline will apply:

- 50% of eligible expenses for investments up to EUR 400,000
- 40% of eligible expenses for investments up to EUR 1,200,000
- 30% of eligible expenses for investments up to EUR 3,500,000
- 20% of eligible expenses for investments up to EUR 9,000,000

The financial envelope for the funding measure makes it necessary to conduct a comprehensive evaluation on the basis of an evaluation plan. The current estimated number of funded projects for the year 2021 and 2022 is 488.

Justification for the intervention

The ongoing, fundamental transformation of the vehicle industry, especially in the supply business, is driven on the one hand by technological breakthroughs in the fields of digitisation, automation and industry 4.0, autonomous driving, and the digitisation and formation of value networks, especially GAIA-X. On the other hand, there is also a transformation towards more sustainable manufacturing methods, electrification of vehicles, and new mobility concepts designed to lower greenhouse gas emissions in line with the climate targets. The vehicle industry is thus faced with two transformation processes that are taking place at the same time. It must find answers to the massive challenges that are resulting in fundamental structural change.

The automotive industry as part of the vehicle industry is of special importance for the economic future of the Federal Republic of Germany. The automotive industry (industrial sector, commerce, after-market) is a pillar of the German economy. It is the economic sector which adds the largest gross value-added to the German economy. It provides a total of approx. 1.6 million jobs in Germany. In addition to this, there are some 650,000 employees working in industries that are closely tied in with the manufacturing of motor vehicles and motor vehicle parts. Due to the high level of division of labour characterising automotive

manufacturing, suppliers, most of them SMEs, now account for approx. 70% of the economic output generated by the automotive industry.
The railway industry is also an important part of the vehicle industry. Like the automotive industry, it is also confronted with disruptive change and challenges. Freight transport, which is currently still predominantly road-based, is to be largely shifted to the railways to promote the efficient and sustainable transport of goods and commodities and to reduce carbon emissions in the transport sector. Similarly, passenger transport will also rely even more than it does today on efficient, sustainable, digital, and interconnected railway services. Modern goods and passenger trains powered by alternative drives where the railways are not electrified, automated railway services, and digital business models and digital corporate processes will help lower emissions in the railway sector and thus contribute to achieving the Federal Government's climate targets. The growing relevance of predictive maintenance in the railway sector has resulted in a high level of interest in digitisation projects on the part of rolling stock manufacturers and their suppliers.

The investment programme seeks to modernise and digitise manufacturing in the vehicle industry to support the transformation of the vehicle industry described above and to mitigate the negative consequences of structural change.
Without corrective intervention by the public sector, this will result in suboptimal levels of investments in digitised, more modern and more energy-efficient production processes and production facilities.
When it comes to innovation and digitising companies' production processes and facilities, technological externalities lead to a non-optimal allocation of resources. The benefits of having a fully digitised, industry-4.0-capable value network in the automotive industry greatly multiply through having an increasing number of "users" or participating companies using digital manufacturing. The exchange of data between companies in an industrial value network through digitised manufacturing processes and the business models resulting from this can be regarded as network effect commodities. However, companies are not aware of the positive effects of digital manufacturing and they incur high internal costs to adjust their business processes and manufacturing equipment. What is more, competitors also benefit from a company deciding to share its own data through digitised production processes in order to increase the overall benefit for all companies involved in an industry 4.0 and Gaia-X environment.
Moreover, the external costs of vehicles being produced without focusing on energy efficiency and an optimal use of resources are not taken into account, or at least not fully, by the companies incurring them. Higher primary energy consumption leads to higher carbon emissions, and insufficient recycling leads to more waste and a higher level of resource consumption, the costs of which may result in a welfare loss. Furthermore, knowledge externalities can lead to companies in the market being unable to fully benefit from the returns gained by training workers or using innovation consulting services to digitise and modernise company processes and production methods.
Also, uncertainties and the risks in technological innovation processes launched with investment can lead to suboptimal market outcomes.
However, digitising production in the vehicle industry is expected to generate major positive spillover effects. When it comes to the required transformation of the entire vehicle industry, in particular, innovations that have been realised in individual value networks can generate momentum that extends beyond the vehicle industry.

SMEs, the group of companies at the centre of the investment programme, also have additional issues specific to them, often resulting from the fact that they tend to have to operate on limited resources and scarce information. This is compounded by a lack of technical and organisational skills and capacities. It follows from the above that it can be expected that SMEs are deterred from making larger investments as many large digitisation and modernisation projects cannot be divided up into smaller chunks. Another reason is that SMEs do not have the same options as larger companies to hedge their investment(s) by building a

large project portfolio. This makes them even more likely to shy away from risks.[5] Another interesting aspect of supporting small and young companies under innovation-policy programmes is that this addresses what is known as the 'innovator's dilemma'[6], allowing them to develop innovations which will then give them an edge over established companies.
This is why government incentives should be used to strengthen private investments in modern and digital manufacturing methods and processes, especially by SMEs. If the intervention is well designed, it should result in higher investment expenditure whose positive results ought to outweigh the negative, both for individual companies and for society at large. Small and medium-sized enterprises benefit strongly from the high funding rates (at low maximum amounts of support) based on the 2020 Federal Framework 'Small amounts of compatible aid' whereas large enterprises are not eligible for funding on the basis of Article 17 and Article 18 GBER. The funding guideline also sets out an SME quota (30% of all funding recipients should be SMEs).

The public intervention is designed to address multifaceted market failures and to thereby create positive momentum for growth and jobs.

Objectives of the investment programme

The above description of the situation at the outset paints a clear picture of the pressure to transform and innovate that the German vehicle industry is having to cope with. The objectives of the investment programme can be divided up into different layers, each based on a different angle. A description of the objectives to be served by the funding guideline in terms of political/strategic objectives, the objectives at programme level, and the objectives at project level can be found in the table below:

	Funding guideline for the 'investment programme for modernising production in the vehicle manufacturing and supply industry'
Objectives at the overarching political/strategic levels	1. Boost the innovative strength of commercial companies in the vehicle industry, especially SMEs[7] 2. Safeguard the technological leadership role held by the German vehicle industry 3. Strengthen research and innovation 4. Promote investments 5. Safeguard jobs
Objectives at programme level (funding measures)	Objectives to be achieved across all funding recipients: 1. Increase investment and innovation spending (thus increasing competitiveness and safeguarding jobs) 2. Increase efficiency and flexibility in production (innovative production technologies) 3. Strengthen resilience (through digitisation and improved flexibility of supply chains and production networks) 4. Provide support in the transformation process 5. Increase resource and energy efficiency for environmentally sustainable production (reduction of greenhouse gas emissions and sustainable use of raw materials/valuable materials) 6. Contribute to mitigating the economic impact of the COVID-19 crisis, stabilise the vehicle and supplier industry as a whole[8]

5 For a general outline of intervention logics underpinning SME innovation programmes seen from an evaluation angle, cf. Boekholt et al. (2014), for instance.
6 Christensen C. (1997)
7 As detailed before, each of the objectives is focused on SMEs as a predominant subgroup of the entire target group. For the sake of readability, the table does not specify this for each individual point. The funding guideline specifies that 30% of all funding recipients ought to be SMEs involved in the projects.

Objectives at project level (projects)	Objectives to be achieved in connection with or as a result of an investment project in the company receiving funding support: 1. Increase investment and innovation spending (thus increasing the company's competitiveness and the resilience and sustainability of the company's production system) 2. Adapt manufacturing facilities to implement innovative and digital production technologies 3. Adapt the manufacturing plants of the companies receiving funding support in order to increase their resource and energy efficiency and to move towards environmentally sustainable production methods 4. Digitise value creation and manufacturing processes in the company receiving funding support 5. Increase the flexibility of production processes towards customer-specific, individualised mass products, product diversification 6. Commercialise innovative digital technologies and production methods 7. Use digital technologies to optimise intra- and inter-company collaboration 8. Transfer knowledge as part of the transformation processes (upgrade employee skills, provide consultancy services)

The investment programme serves industrial-policy objectives and is underpinned by the logics of economic intervention. At the overarching strategic/political levels, the objective is to improve the competitiveness of the German vehicle industry, which would help safeguard jobs. Another intention is to safeguard the German vehicle industry's international market position. The investment programme which provides financial grants towards forward-looking investments is helping to attain these economic objectives by increasing the resilience, flexibility and energy efficiency of production plants and by supporting the transformation of companies in the vehicle sector towards digital processes and alternative drives.
The expectation is that the investment projects receiving financial support under the funding guideline will trigger additional investments and increase the investment and innovation activities in the respective companies, thus helping to raise their levels of productivity and competitiveness, which is in line with the overall economic objectives. At project level, the funding for investment projects aimed at enabling companies to adapt and manage the transformation processes is continuing to help preserve or create jobs (linked to implementing the investment project).

Logic models

The expected benefits of the funding measure are shown in the logic model.s This measures input, output, outcomes, and the impact of the funding guidelines.
Input means all the financial, staffing, and conceptual resources used (funding and own resources, staff, expertise). This input allows for the activities in terms of investment projects to take place.
The output of the funding measure is the additional investments made by the company, and, depending on the specific project, the digitisation of the production process, the increase in energy efficiency resulting from the investment project, the consultancy services used and the staff training carried out.
The outcome, i.e. the results achieved at the level of the target group, corresponds to the effects directly achieved by the input and output. These are the results to be achieved in the vehicle industry, namely

- the modernisation and digitisation of production plants
- greater flexibility and individualisation of production
- acceleration of further transformation processes in manufacturing
- increased digital interoperability and sovereignty
- increased resource and energy efficiency in production and
- corporate networking

8 The objective of mitigating the impact of the COVID-19 crisis is a temporary component which will be highly important in 2021, in particular. The expectation is, however, that the manifold repercussions of the crisis will continue to be of relevance for the companies working in the vehicle sector for years to come.

The associated long-term effects and impacts intended are the following:

- enhanced competitiveness
- growth of companies in the vehicle industry, and
- a contribution to managing the fallout from the COVID-19 pandemic

The anticipated chain of causality by which capital investments to modernise the production processes in view of CO2 reduction and digitilisation is described in more detail below and may lead to economic and other impacts as follows:

Inputs: The investment programme will typically represent a small share of the overall cost of capital investment projects, with the rest made up largely of finance provided by the applicant (from reserves, debt or equity).

Activities: Projects will largely involve the acquisition of production facilities and installation of new plant machinery.

Gross CO2 reduction and efficiency gains due to digitilisation: Firms benefitting from the investment programme will either use less energy and CO2 or reduce costs due to improved and integrated processes.

Deadweight: If grants are targeted at marginal projects that would not have gone ahead in their absence, the investment programme would be expected to lead to increases in capital expenditure/investment. If grants ease constraints in credit markets, companies would also be expected to see increases in profitability. A key issue for the impact evaluation will be to determine how any such outcomes can be observed, and how far they would have occurred in the absence of the investment programme.

Displacement effects: If an modernisation projects also expands the productive capacity of the company, it will potentially lead to short term displacement effects. If beneficiaries expand their production and sales at the expense of local or other competitors, then there may be offsetting losses of output within those firms. If the competitors are largely based outside of Germany (as might be expected if firms are producing largely for export markets), then such offsetting effects may be small at the national level. Where firms compete primarily in national markets, such effects may be stronger. There are also internal substitution effects to consider, in other words what the company would have done in the absence of the project (i.e. would it have proceeded with an alternative project, perhaps in a different location).

Net CO2 reduction and efficiency gains due to digitilisation: Accounting for the displacement effects will provide estimates of the net impact on CO2 and efficiency.

Selection criteria and approval procedure

Applications are processed in the order in which they are received. A decision can be made only after the complete application has been received. Approval is granted within the scope of the project's suitability and the funds available. The applications received will be evaluated according to the following criteria and simplified single-stage approval procedure:

- Content: Relevance to the funding objectives and funding purpose of this funding guideline as stated in the investment programme
- Timing: according to the receipt of applications
- Financial: according to the availability of budget funds

The assessment focuses on whether the project meets the funding purpose and whether the applicants are eligible to receive funding. One reason why an application for funding is rejected can be that the project does not fit the conditions of the investment programme and/or there is a lack of financial capacity in the company. In addition, it could also be the case that companies are unable to demonstrate that they experienced a decline in sales due to the COVID-19 pandemic (one of the selection criteria) and therefore did not apply for funding. Rejected projects might also be registered because the company does not predominantly belong to the vehicle industry.

The period of time within which the project is to be implemented and ready for operation (approval period) is as a rule twelve months after the notification of the grant has been issued. Deviations from the project approved in the notification must be notified immediately to the approval authority.

Overview: objectives, evaluation questions and core result indicators

Objectives	**Evaluation questions**	**Result dimension**	**Core result indicator**
Technological leadership	Has the scheme contributed to the relevant policy objective? Has the programme as a whole boosted the innovative strength and the technological leadership role?	Competitiveness	Global position of the industry
Investment in new machinery and equipment	Was it possible to achieve an initial effect? Have companies with low investments level increase their investment expenditure?	Positive economic impacts	Investment expenditure
Investment in digitilisation	Do the funded projects result in increased investment in the area of digitalisation? Do investment in digitalisation expenditures differ between funded and comparable non-funded enterprises?	Positive economic impacts	Investment expenditure in digitilisation
Investment in environmental sustainability of production	Do the funded projects result in increased investment in the area of sustainable production? Do investment in sustainable production expenditures differ between funded and comparable non-funded enterprises?	Positive environmental impacts	CO2 reduction
Secure employment	Did the support help to secure jobs in the supported companies?	Positive economic and social impacts	Number of employees
Introduction of process innovation	Do the funded projects result in increased investment in the area of process	Positive economic impacts	Investment expenditure in

	innovation? Do investment in process innovation differ between funded and comparable non-funded enterprises? What influence did the funding have on the introduction of process innovations in the company? What costs could be saved through process innovations?		process innovation Innovation output (product and process innovations)
Identification of indirect effects	Has the scheme had positive spill-over effects on the activity of other firms? What negative indirect effects (if any) did occur during promotion and are there any special features?	Positive or negative economic impacts	Investment expenditure in digitilisation
Proportionality and appropriateness	Was the investment programme proportionate to the problem being addressed? Could the same effects have been obtained with less aid or a different form of aid? Was the most effective aid instrument chosen? Would other aid instruments or types of intervention, including non-aid options, have been more appropriate for achieving the objective in question? Is there a need to redefine the objectives and/or the target beneficiaries to achieve the same policy objectives?	Adequacy and efficacy	Qualitative assessment

Main assumptions and potential issues of the evaluation

The evaluation of the investment programme will addresses a broad range of different projects for all kinds of technology and modernisation of production in the vehicle manufacturing and supply industry. It is therefore to be assumed that the funding effects are heterogeneous. As average effects only account for a part of the whole range of impacts, the evaluation will try to analyse, where possible, potentially heterogeneous impacts of the scheme. This could for example with regard to different types of undertakings (size, age, R&D intensity, etc.), location or according to the different types of projects (sustainability, digitilisation, training, etc).

Heterogeneity of companies

Statistical models for impact often assume a standard 'normal' distribution of observations around a mean. However, the impacts of modernisation investments tend to be skewed towards a smaller number of very successful projects and many low to medium impact projects. This profile of impacts or returns can undermine the statistical models being used. There is an important implication: evaluation methods seek to calculate the 'average treatment effect', i.e. the mean impact of a scheme on

a beneficiaries. Where impacts are highly skewed, this can be misleading. In cases where the high-impact subjects are missed by the evaluation, impacts could be under-reported. However, BMWi assumes that the impacts of modernisation are not as skewed as e.g. R&D or innovation outcomes and impacts.

Duration and lagged effects

Modernisation measures and support hereof often take place over a number of years. Although the specific supported projects by this investment programme usually only last 12 months, programme's impact is expected to be seen over a longer period. The impacts of the modernisation measures usually occur later. Once they do materialise, they can last a number of years.

In the initial years following public support, it can appear that returns are low or non-existent. OECD (2009) and Hodges (2010) have shown that companies that are modernising or innovating (rather than those that have innovated or have already undergone modernisation) are less productive than those that are not, as they are investing resources into innovation and modernisation before realising any revenue or efficiencies from the project.

To address this issue, the evaluation plan suggests that the evaluation is designed to span a wide time frame, from the start of projects to several years beyond their formal end. The evaluation plan proposes a mid-term evaluation around 2022 to assess initial impacts and a final evaluation for 2026 to evaluate the programme's impacts. We assume that by 2022 only a minor percentage of projects will have been completed. Further issues arise in such long-term evaluations, like people moving on and memories fading. The evaluation plan ensures data is collected as project are implemented, and that expectations for data collection and reporting are set early in the process.

Attribution of impacts

This scheme for the automotive sector is part of a complex support, innovation and modernisation system. In Germany, there are many organisations at national and sub-national levels providing a variety of support that companies may interact with before, during, and after support by this particular scheme. Indeed, companies may be involved in many types of support scheme from different ministries or agencies at the same time. Identifying the contribution of any single programme with observed modernisation or improvements is difficult. The support of any single programme is often necessary for outcomes to be realised, but not sufficient in itself.

Attribution can also be an issue around ongoing and additional private sector investment in modernisation. If the data cannot account for this then attribution of impacts becomes more complicated.

The evaluation plan suggests to take some steps towards controlling for the wider policy environment, using surveys to ask about other public support received, and data on other programmes. However, the full complexity of the environment cannot be captured and controlled for through these techniques alone.

A possible solution for this issue could be to make use of data from overall support databases like the German Förderkatalog ("Support catalog") to allow for a more complete picture of businesses that receive multiple forms of support. The evaluation can use such data to look at companies that have received support from the BMWi and the German Research Ministry (BMBF) programmes (and others). This will allow to assess if there is a potential issue with attribution. However, data from from regional or local support scheme, enterprise partnerships, growth hubs or similar are not compiled. The inclusion of more programme data could allow a more complete, robust analysis of the impact of multiple interventions for a single company.

Endogeneity

Endogeneity occurs in econometric models where a variable being used to explain an outcome – for example modernisation support being used to explain business performance – has a correlation with other variables that also affect the outcome but are not captured in the model. In the case of the scheme, this could be a company's sustainability ambition. Ambition could affect a company's likelihood of applying for modernisation support, and could also affect that company's performance. If sustainability ambition is not controlled for in the model, the results will be biased and either under or over-stated, see e.g. Department for Business, Energy and Industrial Strategy (2015). It is fairly likely that there are several factors that could lead to an endogeneity problem, not least due to an ambiguous cause-and-effect relationship between modernisation and performance, and that the observable characteristics – such as the age, size, or sector – of a company only explain a small part of modernisation and growth, and unobservable characteristics
play an important role.

Wider impacts

Impacts identified and assessed in an evaluation should be measured against a baseline of what would have happened had the aid (intervention) not occurred. Gross impacts need to be adjusted to discount for what would have happened anyway – the 'deadweight'. The evaluation will estimate the extent of deadweight in the investment programme by using control groups. However, additionality and deadweight are not straight forward, and headline numbers need to be treated with some caution. Beyond deadweight and what is possible to infer from a counterfactual, there are wider effects to consider in the evaluation.

- Displacement: where positive outcomes of a programme are offset by negative outcomes elsewhere. For example, where the project supported by the investment programme leads to an increase in the company's market share due to the modernisation of a production process, other companies might see their market share reduced.
- Substitution: where the effects of an investment programme are realised at the expense of other activities. For example, where the modernisation scheme triggers investments in one modernisation project at the expense of an alternative modernisation project, which could also have positive outcomes.
- Leakage: where the investment programme benefits 'leak' to those companies outside the target group. For this investment programme, this would mean that some or all of a programme's benefits accrue to companies outside of the sector or outside of the country. The leakage effect of this scheme is assumed to be minimal.
- Knowledge diffusion: where beneficiaries of an investment programme develop new knowledge and then move on and apply it to projects not associated with the project or company. These spillover benefits are generally found to be large – often larger than the direct benefits of innovation support, see Department for Business, Energy and Industrial Strategy (2015). For this investment programme, BMWi assumes that there will be minor to no spill-over effects.

Evaluation questions

The evaluation questions define the scope of the evaluation. The evaluation will mostly focus on how the aid directly impacts on the behaviour of the beneficiaries.
The evaluation plans foresee to assess the direct incentive effect of the aid on the beneficiary:

whether the aid has caused the beneficiary to take make (additional) investments, and how significant was the impact of the aid on the investment behavior?

The following specific questions regarding direct impacts will be considered:

- Has the scheme contributed to the relevant policy objective? Has the programme as a whole boosted the innovative strength and the technological leadership role?
- Was it possible to achieve an initial effect? Have companies with low investments level increase their investment expenditure?
- Do the funded projects result in increased investment and innovation efforts in the area of digitalisation and modernisation? Do investment and innovation expenditures differ between funded and comparable non-funded enterprises?
- Do the funded projects result in increased investment in the area of sustainable production? Do investment in sustainable production differ between funded and comparable non-funded enterprises?
- Did the support help to secure jobs in the supported companies?
- Do the funded projects result in increased investment in the area of process innovation? Do investment in process innovation differ between funded and comparable non-funded enterprises?

The investment programme does not explicitly aim to trigger positive spill-over effects like knowledge-, networks- and market spillovers or the development of the company networks. As concerns indirect impacts, general investment or modernisation schemes can have an impact on a whole sector, however, they are assumed to be much lower than spill-over effects due to R&D activities that can have an impact on several sectors or the whole economy. The future evaluation should address and examine if there are any possible indirect effects of the investment programme. The following specific questions regarding in direct impacts will be considered:

- Has the scheme had spill-over effects on the activity of other firms?
- What negative indirect effects (if any) did occur during promotion and are there any special features?

Proportionality and appropriateness

The appropriateness of the measure will be evaluated by looking at alternative intervention models, e.g., loans instead of grants. In particular the evaluation plan suggests investigating the cost of deployment to the investment and investment programme.
The proportionality will be examined by comparing long-term investment trends and actual take-up of investment, and the number of beneficiaries withdrawing or abandoning a modernisation and investment project.

The future evaluation will look at:

- Was the investment programme proportionate to the problem being addressed?
- Could the same effects have been obtained with less aid or a different form of aid?
- Was the most effective aid instrument chosen?
- Would other aid instruments or types of intervention, including non-aid options, have been more appropriate for achieving the objective in question?

- Is there a need to redefine the objectives and/or the target beneficiaries to achieve the same policy objectives?

Result indicators

The evaluation questions above lead to the following specific result indicators that quantify the impacts of the investment programme. The following set of result indicators are the most relevant given the objectives of the investment programme:

- Indicators for the implementation of the scheme: number of projects supported, funding volume, etc.;
- Increase in investment expenditure of the beneficiaries, in general and of broad objective categories (investment in new machinery; investment in industry 4.0-ready plants; investment in digitilisation; investment in environmental sustainability of production; process innovation investment in advisory service and qualification measures)
- Changes to the environmental impact of beneficiaries, in particular CO2 reduction;
- Changes and trends in employment, number of employees;

In addition, further indicators will be used depending on data quality and availability:

- Efficiency and flexibility in production: processes towards customer-specific, individualised mass products, product diversification
- Resilience: digitisation and improved flexibility of supply chains and production networks
- Support in the transformation process
- Resource and energy efficiency for environmentally sustainable production: sustainable use of raw materials/valuable materials)
- Mitigation of economic impact of the COVID-19 crisis
- Implement digital production technologies
- Increase the flexibility of production
- Commercialisation of innovative digital technologies and production methods
- Use digital technologies to optimise intra- and inter-company collaboration
- Knowledge transfer as part of the transformation processes; upgrade employee skills, provide consultancy services
- Turnover, profit, surplus, or contribution margin
- Labour productivity
- Educational level of the company's employees

The intended examination of sub-groups, for example according to particular types of business, size or project type will make it possible to map heterogeneous funding effects.

Envisaged evaluation method and appropriate comparison group

The evaluation of the investment programme tries to identify the causal impact of the scheme itself, undistorted by other variables like macroeconomic conditions or firm heterogeneity. This causal impact is the difference between the outcome with the aid and the outcome in the absence of the aid. A specific problem emerges in terms of identifying a control group because beneficiaries and non-

beneficiaries have decided themselves to apply or not to apply for aid in this scheme. Since most firms are eligible, i.e. all firms who propose a project and apply for aid most likely will receive some aid, then the firms who do not apply are likely to be those without projects. The firms' results may show that firms that did not receive aid performed worse in absolute and relative terms than those who did receive aid. This finding may however be entirely explained by the mere fact that the first group had no project to begin with, whereas the second did, i.e. the management of the former group are lacking interest or creativity.
It is therefore crucial that firms in the control group (firms who did not benefit from aid) are part of that group for reasons that have no influence on the measured outcomes. In particular, where firms have self-selected and voluntarily decided not to apply for aid, this condition may not be fulfilled.

The investment programme have not yet been evaluated, and therefore, there are no lessons learned from previously deployed evaluation methods. In particular, there is no study using micro data to understand the impacts and no study to provide a systematic examination of the possible heterogeneity of effects for the various groups of enterprises.

In order to study the evaluation questions, it makes sense to provide for method and data triangulation. In this way, various sources for the interrelationships and conclusions can be sought, which should permit not only plausibilisations but also reciprocal control of the findings. In addition to the combination of different data sources, there should also be a combination of quantitative and qualitative methods in the evaluation design (with a focus on analytical and quantitative methods) with a view to improving the overall robustness of the findings. Indicators deriving from the quasi-experimental methods and poor results in terms of indirect effects can then be followed up by qualitative methods. In this way, it can be possible to arrive at conclusions, for example about long-term effects of the intervention which are difficult to demonstrate in quantitative terms within the reference period. Case studies and questionnaires will supplement some of the qualitative methods and are foreseen to be conducted during the programme implementation. The complementary addition of a variety of approaches in the mix of methods is intended to reduce the individual strengths and weaknesses of individual methods. A sensitivity analysis also appears useful in order to examine the quality of the results of the methods used. The use of qualitative methods can deliver not only contributions to the quantitative analysis of the degree of the effect of the intervention, but also data answering questions about the cause of certain effects and the underlying mechanism. Further ideas for the evaluation itself are expected to derive from the ongoing procedure inviting bids for external evaluation.

During the preparation of this evaluation plan, BMWi made an appraisal of all major methods discussed in the European Commission's working document and in other pertinent sources to identify the most suitable evaluation approach. The following paragraphs discuss the rejected evaluation methods and explains which method is consider the most appropriate.

Randomising the process used for selecting beneficiaries is one way of making sure that the evaluation is unbiased. Due to randomisation, there is no systematic difference between beneficiaries and non-beneficiaries apart from the aid and the difference in the outcomes can be attributed to the policy. Randomised field experiments present legal and political difficulties and are not suitable for this investment programme. A natural experiment, which could only come about if enterprises were unable to influence any potential funding, is also not an option.
A simple way of setting up a control group without selection bias would be if the annual budget available for the funding measure is exhausted and applicants are rejected for this reason only. The comparison between recipients and applicants rejected for lack of funding was used by Martini and

Bondonio (2012).[9] Unfortunately, it is not possible at this present time to estimate whether the very substantial budgetary funds available will be used up in one of the funding years and thus whether the case described will be able to reconstruct the counterfactual case to a sufficient degree.
BMWi does not recommend to use randomisation to evalutate this investment programme.

Regression discontinuity design is another possible method that BMWi rejected since there will be most likely no or too few "rejected" applications for project funding. In addition, applications cannot be excluded with regard to a certain region, age, or size of a company. Regression discontinuity design might be used if the funds that are available for aid reach their limit. In the case of this state investment programme and based on previous experience this is very unlikely. Regression discontinuity design might be used in the future in case there will be a change in the eligible sectors of the investment programme.

Instrumental variables is a another method for evaluating interventions and, in particular, to deal with endogeneity of explanatory variables. This method could be very useful for the investment programme because the set up of the investment programme does not really allow to withhold interventions from some businesses or allocation has already occurred (and was not based on a score or randomisation). Since benefiting from aid can be seen as an endogenous explanatory variable of the performance of a firm, it is natural to use an instrumental variable to evaluate the effect of aid. For the evaluation of this investment programme, an instrumental variable is a variable that can explain the fact of receiving the aid but has no direct impact on the other unobserved determinants of the outcome that has to be measured.
BMWi experts and programme managers tried to identify an instrumental variable that could be assumed to be uncorrelated with the unobserved determinants of the performance of firms. However, presence of a convincing instrumental variable was not yet clearly identified and there are no straightforward candidates for instrumental variables available. In case that the future evaluator will identify an instrumental variable BMWi is open to apply instrumental variables for the evaluation of the scheme, but would like to recall that the instrumental variable should determine the state aid but not the modernisation investment, i.e. a simultaneous requirement of "participation determination" and "non-influence on the outcome of participation".

BMWi recommends a quasi-experimental method for the evaluation of the causal impact of the scheme if the quality of available data is sufficient, see section data availability and data collection requirements. The so-called 'conditional Difference-in-Differences' approach, which combines two common methods: difference-in-differences, which allows for unobservable individual heterogeneity to be controlled, and matching, which aims to control for the influence of observable factors.

The method can be used for this investment programme since many of the differences in characteristics are typically observable, e.g. size, age, investment intensity, employment trends, etc. In the case of matching, comparing the outcomes between a beneficiary and its matched 'twin' without aid, allows avoiding the selection effect only if the granting of the aid is unrelated to unobserved variables that also influence the outcome. The justification for the use of matching relies on the fact that the unobserved reasons that explain eligibility have no direct or indirect influence on the outcomes (once controlled for the observables). In the case of this investment programme the funded projects are of fairly general purpose, i.e. modernisation of production, and it can be assumed that the overall majority of companies will have at least one project or investment need for modernisation.

9 A. Martini, D. Bondonio: 'Counterfactual impact evaluation of cohesion policy: impact and cost effectiveness of investment subsidies in Italy' (2012).

Therefore, matching on observables is most likely to disentangle the two groups of funded and non-funded companies.

However, special consideration with regard to large companies from the vehicle industry (a sub-group of the treatment group) should be taken into account. In particular, the large OEMs and Tier 1 suppliers to the vehicle industry, forming part of the assisted large companies, have very large workforces and high turnovers, as well as individual corporate strategies and philosophies, which can make it harder to undertake a matching procedure, irrespective of data availability. It can be assumed that all the very large companies in the vehicle industry are aware of the investment programme. Here, it is necessary to consider whether and how appropriate matching is possible and if appropriate to take a case-by-case approach and use case studies to determine indicators of causal interconnections. To this extent, qualitative methods can usefully supplement the mix of methods.

The evaluation will have to take into properly account of any systematic difference between scheme beneficiaries and non-beneficiaries. By doing this, he design of the evaluation will avoid a bias in the results. In order to assure the necessary rigour, the evaluation will base the construction of the control group on a wide set of structural and behavioural variables, depending on data availability and quality, and which should include:

- level of capital investment,
- level of CO2,
- employment,
- labour productivity,
- sales and/or profit,
- investment expenditure pre-intervention,
- average age of machinery and fixed-capital investment.

The evaluation should do as first check and compare the variations of outcomes of the beneficiaries and the control group before the aid. If the outcomes systematically start diverging already before the aid has actually been granted, it is likely that the control group and the group of the beneficiaries are diverging for reasons unrelated to the aid and the method does not give a valid estimate of the causal effect of the aid.

BMWi also foresees that the future evaluator should assess the usefulness of further control groups, like companies from other sectors or companies form the automotive sector in another country (in case no similar scheme is in place). This could also be a convincing setup since non-participation is related to non-eligibility. In this case, non-eligibility is unlikely to be due to unobserved factors that also have an influence on the outcomes. However, the data availability, in the case of companies from other countries, could be a major issue.

In order to examine the effects of the measure on competition, the evaluation should assess whether it is possible to measure the the market share of aid beneficiaries. This could be feasible if the beneficiary company are active in homogeneous product markets. This could be compared with a counterfactual established on the basis of non-intervention areas, i.e. companies in other countries. In the course of the selection of the future evaluator, the extent to which further analytical methods can be deployed, e.g. to o investigate any changes in the nature of competition, should be proposed and examined. The plan is that bidders should be given the possibility to propose further methods when the evaluation tender is published.

In any case, the future evaluation will address the issue whether the identified impacts are economically significant.

As a complement, and in case the required quality of future micro-data is not given, the evaluation plan foresees the usage of workshops (also to be used to involve stakeholders), case studies and interviews (with beneficiaries and non-beneficiaries), in order to have a general understanding of reasons why the causal relation inferred by the quantitative analysis took place and to qualitatively estimate the impacts.

Data availability and data collection requirements

Data availability is crucial for an insightful evaluation. In particular, the availability of micro data is essential since they allow to measure what has happened before the scheme (pre-intervention).

A distinction needs to be made between the data available for the group of recipients (treatment group) and the control group of non-recipients. For the treatment group, the administering agency, the Federal Office for Economic Affairs and Export Control (BAFA), will capture, prepare and provide a host of different company-specific and project-specific data through the project managers. This data will include company names, addresses, industries, turnover, and the size of the workforce. Data relating to the project and available to the administrating agency include the type of project (digitisation, improvements in energy efficiency, training etc.), project volume, amount of funding, and statements made by the aid recipient on the intended adaptation of the production process, carbon emissions savings, and other considerations made by the applicant regarding the investment project. Most of the company-specific and project-specific data are gathered in the project funding information (profi) system. Beyond this, some basic data of the companies whose application has been rejected are also recorded, meaning that there are some data on these companies.

An external database for data on the group of aid recipients, but also (and to a greater degree) for data on the control group is required for the evaluation. In principle, there are public and semi-public statistics available from the public administration and from non-profit organisations, but these are of limited use for the evaluation, given that some key variables are not on record. There are also smaller data sets on a few thousand companies, which, again, do not meet the needs for measuring effects to the necessary degree. While, in principle, it would be possible to combine several different data sets, there will often be an insufficient number of companies whose data will be present in all of the data sets.

In principle, several relevant sets of data will be taken into consideration and checked as to whether they comply with the minimum requirements for data quality and data availability for quasi-experimental methods. The Manual published by the Danish Ministry of Higher Education and Science, a relevant piece of literature on the subject, defines a minimum of variables to be taken into consideration when compiling a control group for R&D and innovation funding programmes, stating that the data base ought to have the format of balanced panel data, Christensen et al. (2014). These considerations on the minimum set of variables are applicable only to a limited extent to the investment programme considered here, but general guidance and rules for the evaluation are provided. For example, the use of too many explanatory or too many identical variables generally ought to be avoided in the interest of preventing falsified results and interdependencies between different parameters.

Among the existing sets of data, the Mannheim Innovation Panel (MIP)[10] is to be given special consideration and scrutiny. Its set of variables includes a core set of data that has been continuously recorded since 1993 (annually), and which is being widened for samples taken at certain intervals. All large companies and many SMEs from the goods-producing sector, including the automotive and rolling stock industries which are highly relevant to the investment programme, are included in the Mannheim Information Panel.

The set of variables available for the evaluation is to be as follows:

- turnover
- innovation output (product and process innovations)
- labour productivity
- educational level of the company's employees
- profit, surplus, or contribution margin
- company size (number of employees)
- industry affiliation
- export intensity
- spending on innovation
- spending on investments (investments in material assets, ICT investments)
- share of sales from product innovations and market innovations

The range of variables in the Mannheim Innovation Panel (*Mannheimer Innovationspanel*, MIP) of the Centre for European Economic Research can be considered for the construction of the control group . The MIP is an annual written survey of approx. 7 000 independent enterprises with more than five employees. The MIP sample is updated every two years by a random sample of newly founded enterprises to replace any companies which may have dropped out. The panel style of the survey means that companies can be observed over a longer period of time. The identification number of companies allows to link data in the MIP with data from the project promoters. However, the MIP data is focused on R&D and innovation behaviour. Since this is not the main focus of the investment programme, the future evaluation should also consider other German micro data.

The evaluation will be partially based on quantitative analysis of data collected directly from beneficiaries through their grant contract. These reporting obligations will require the beneficiaries to report standard metrics. The databases of the scheme‘s project promoter contain important key information for evaluating the scheme: enterprise-specific details such as the company name, address, economic sector and revenue, project-specific details regarding the type of project, duration, amount of funding and technology field. The reliability of this pool of data is high and it can therefore be relied upon in the upcoming evaluation.

The Research Data Centre of the Federal Statistical Office (RDC, www.forschungsdatenzentrum.de) enables access to official microdata via differently anonymised data products. However, the full possibilities to use microdata are net yet in place and continuous improvement of the data infrastructure is being undertaken. RDC has made linked individual data of the official economic and environmental statistics available. The most relevant data set to evaluate the investment programme appears to be the "Official Firm Data for Germany (AfiD)". The AfiD data set combines all micro data of the economic and environmental statistics, and thus increases the analysis potential of the data: For

10 More information on the MIP is provided by the Leibniz Centre for European Economic Research in Mannheim at: https://www.zew.de/forschung/mannheimer-innovationspanel-innovationsaktivitaeten-der-deutschen-wirtschaft/

individual companies, information from different statistics can be used together and temporal analysis and cross-economic developments are also facilitated.

AFiD panel for industrial enterprises in the manufacturing sector links the following surveys:

- the annual report for manufacturing enterprises,
- the Annual Investment Survey of Enterprises in Manufacturing,
- the Cost Structure Survey of Manufacturing.

The panel data provide, among other things, information from the companies on the economic sector, employment figures, turnover, investments, wages and salaries and cost structures. They enable differentiated analyses of company success.

Linking AFiD data (or any other panel data) with external data sources from the programme promoter should be also foreseen. For this purpose, it makes sense to use unique identification numbers, such as the ones used by creditworthiness rating agencies or the trade register. The administering agency can ask for these to be supplied as part of the application or thereafter, so that they become part of the data set held by the administering agency. The Federal Ministry for Economic Affairs and Energy can then ask that the data sets be linked up with one another.

As a supplement to the AFiD panel on industrial enterprises, a module on the energy use of the enterprises of the corresponding economic sector is also available. Information on energy consumption and use is recorded. For the enterprises, information is available on electricity purchases and sales, and also on their own electricity generation. The information on fuel purchase and consumption and on fuel supply and stock of the enterprises is partly recorded according to energy sources. This makes it possible to examine environmentally relevant characteristics together with economic variables. It should be taken into account that energy characteristics per se are only comparable with each other to a limited extent across all years. The AFiD module can be used in cross-section or in longitudinal section.

However, it should be underlined that the RDC does not (yet) represent a fully integrated micro data infrastructure or a complete longitudinal business database. Further development work is still carried out to link and integrate more data set and decrease the publication lag of available data set.
The future evaluation should however consider the use of RDC to gain insight into the economy and the impact of the investment programme.

Regardless of the future developments of RDC and the use of MIP, BMWi plans to run an own survey with beneficiaries and scheme managers, to use case studies and conduct interviews.

The future evaluation should make use of the overall German support database “Förderkatalog” (“Support catalog”) to identify businesses that received multiple forms of support, see also section “attribution”.

Timeline of the evaluation

To capture initial effects and the causal links a mid-term evaluation report based on the present evaluation plan will be submitted to the European Commission by June 2023 at the latest. Given the average project term of 12 months, the first wave of completed modernisation projects is to be expected in end 2022. The data panels like MIP or AfiD will have entered the results from their surveys

into the pool of data only at a much later date. Nevertheless, the future evaluation should attempt to construcct a “pilot” counterfactual scenario and consider the mid-term evaluation as a pilot exercise on the chosen method. The mid-term evaluation will deliver insight for the adequacy of the evaluation method and its feasibility. Most of the insights of the mid-term evaluation will be based on the BMWi own survey, workshops and interviews by the scheme promoter.

In addition, BMWi commits to inform the European Commission informally by an annual email with a short update on the progress on data collection, the opinion of the scientific advisory committee, and the state of implementation.

To capture full effects of the investment programme a final evaluation report based on the present evaluation plan will be submitted to the European Commission by June 2027 at the latest or six months after the scheme is scheduled to end. At the time of writing there were no plans to extend the investment programme beyond 2026.

BMWi commits that, should significant modifications to the evaluation plan become necessary, BMWi will notify to the European Commission an updated evaluation plan. BMWi also commits to inform the European Commission of any element that may affect the implementation of the evaluation plan.

The evaluation reports will be published (not later than within 3 months from their approval) on the BMWi website. BMWi will use the evaluation results to inform the scheme design of any future or similar modernisation and low-carbon interventions.

Independence of evaluation and publicity

BMWi will ensure that the evaluation of the impact of the investment programme will be as objective and rigorous as possible. It will also make sure that the evaluation will be impartial and transparent. The evaluation will form part of the wider BMWi Evaluation Framework. The final evaluation in 2026 will be undertaken by an independent body.
The selection of the independent evaluators is due to be put out to public tender in 2021. After completion of the tender, the evaluation will still be ready to start in 2021. The evaluator will not be able to go ahead with the econometric analysis based on the micro and panel data before the end of 2022 due to the time constraints outlined above. However, the evaluator will have greater flexibility in the timing of all other aspects of the evaluation work. The BMWi will include the provision of information on interim results as a requirement in the tender,

The selection of the evaluator will be based on independence, experience and skills of the evaluator. The external independent evaluator will be selected by way of an open, competitive and non-discriminatory tender procedure. Specific skills and experience on evaluation will be required during the tendering. The evaluation should be conducted on the basis of sound methodologies, by experts who have the adequate and proven experience and the methodological knowledge to carry out the exercise.

The evaluation will be made public and published on BMWi website. Personal and/or confidential data will be dealt with according to the relevant regulations. The published results of the evaluation will comply with provisions of the German statistical law and statistical secrecy. Access to third-party data will be subject to the rules imposed by these third-party bodies. Data collected during the evaluation will be made accessible for the purpose of replicating results or for further studies.

Outreach activities will be conducted, for example by preparing and presenting the key results to the stakeholders and/or wider public. More specific technical results will be explained to a selected expert audience. Both the mid-term evaluation and the feedback received from interested stakeholders, e.g. through the workshops or interviews, are expected to give rise to useful suggestions and ideas for the optimisation of the investment programme.

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