# Evaluation plan

for the specialist programme

‘New vehicle and systems technologies’ (NFST)
[Notification of amendment for the 2021 funding scheme]

# 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 specialist programme "New vehicle and systems technologies (NFST)", hereinafter: "NFST", " specialist programme" or "scheme".

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 NFST 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:

- Objectives of the investment programme to be evaluated,
- Evaluation questions,
- Result indicators,
- Envisaged methodology to conduct the evaluation,
- Data collection requirements,
- Proposed timing of the evaluation including the date of submission of the final evaluation report,
- Description of the criteria that will be used for the selection of the independent body conducting the evaluation and
- Modalities for ensuring the publicity of the evaluation.

The national legal basis of the scheme is the programme's funding guidelines "Förderung von Forschungs- und Entwicklungsprojekten im Rahmen des BMWi-Programms 'Neue Fahrzeug- und Systemtechnologien'" (dated 12th June 2015, modified 19th November 2018 and 16th March 2021).

# Brief description of the scheme to be evaluated

Since 2015, the funding scheme for the NFST specialist programme[1] has been the instrument used by the Federal Ministry for Economic Affairs and Energy to support application-oriented research and development projects (collaborative R&D projects) belonging to the pillars of 'automated driving' and 'innovative vehicles' in the early development phase so as to promote innovation in these fields of the vehicle industry.
The NFST specialist programme of the Federal Ministry for Economic Affairs and Energy (BMWi) is the successor to the Federal Government' transport research programmes.

## Concept and objectives

The objectives of the NFST have been adjusted to the current technological, political, and economic framework. By contrast, the funding terms remained largely unchanged. The funding comes in the form of non-repayable grants worth a given proportion of the cost of collective R&D projects which have been found, on the basis of the funding scheme, to be conducive to the objectives set out in the specialist programme.

## Design of the NFST specialist programme

Under the Federal Government's Stimulus and Future Packages[2], which are 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 Packages lit. 35c)[3] has been created, under which the NFST specialist programme is being once again expanded in terms of scope and funding.[4]

The scope of the programme has been widened to include 'systems technologies' as a third pillar. Furthermore, feasibility studies for vehicle and systems technologies are now also eligible for funding. In this way, the funding scheme has been adjusted to accommodate the latest developments in the technical, political, and economic framework, namely a trend towards transformation to alternative drives and digitisation, and a tendency towards linking business models up with the vehicle system itself – all of which calls for greater freedom to pursue innovative ideas and ways of putting these into practice.
The increase in the financial envelope makes it necessary to conduct a comprehensive evaluation on the basis of an evaluation plan.

The main target group are commercial companies in the vehicle industry, especially small and medium-sized enterprises (SMEs). The vehicle industry is understood as comprising all vehicles used in land transport, especially automotives (cars and trucks), other commercial vehicles, and rolling stock. In the following, the focus will be on the automotive, commercial vehicle and railway industries as these are the priority areas of the funding measures (without other modes of land transport being excluded, however). Other stakeholders, such as higher-education institutes, research institutions, or federal, regional, or local authorities, can also receive funding if they are

1 The specialist programme can be found in a separate strategic document. The funding scheme for the NFST specialist programme, which is the actual basis for the funding, makes reference to this document, which sets out the objectives of the funding, its priority areas, etc. Both documents are available for download at www.fahrzeugtechnologien.de.

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

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

4 The notification of amendment of the funding scheme was published in the Federal Gazette on 24 March 2021, upon which act the amendment entered into effect (Federal Gazette AT 24 March 2021 B1).

involved in a collaborative research project and if the funding is conducive to collective progress towards the intended objective.

The funding is provided on the basis of the General Block Exemption Regulation (GBER). The maximum funding rates are based on the attribution of the eligible project costs to the aid categories and aid intensities as per Article 25(5) GBER.
The level of aid intensity per recipient must not exceed the following caps:

a) 50% of the eligible costs for industrial research;
b) 25% of the eligible costs for experimental development;
c) 50% of the eligible cost for feasibility studies.

In principle, funding can only be provided if the aid recipient covers an adequate share of the eligible costs, at least 50% of these costs themselves. In 2021, aid intensities for SMEs can be increased to up to 80% by means of aid intensity bonuses that are in conformity with the GBER. Higher education institutes and research institutions can receive up to 100% of their expenditure/costs in funding, although it is possible for a contribution to be asked of them as well. The NFST specialist programme has undergone an external evaluation, which was concluded in September 2019. The final report[5] provides important information and serves as a basis for an indicator system to be used in the drafting of the evaluation plan.

## 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 digitisation and the 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. This means that the vehicle industry is confronted with two transformation processes unfolding at the same time.

It must find answers to the massive challenges that are resulting in fundamental structural change. The automotive industry, and by extension 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 traffic, still predominantly road-based, is to be largely shifted to the railways so as to speed up the development towards an efficient and sustainable transport of goods and lower $CO_2$ emissions from transport. 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 corporate processes will help lower emissions in the railway sector and thus contribute to the Federal Government's climate targets. The growing relevance of predictive maintenance in the

5 Prognos AG. (2019). The Federal Ministry for Economic Affairs and Energy's specialist programme 'New vehicle and systems technologies'

railway sector has resulted in a high level of interest in digitisation projects on the part of rolling stock manufacturers and their suppliers.

Without corrective intervention by the public sector, this will result in suboptimal levels of investments in R&D. Companies cannot fully reap the benefits of R&D projects due to knowledge and network externalities. A lack of certainty and the risks relating to technological R&D processes, and a lack of certainty and the risks relating to any cooperation the company has entered to (IPRs, transaction costs) can also result in market outcomes that are less than optimal. This is despite the fact that collaborative projects can be expected to have a high level of positive spill-over effects. In the context of the necessary transformation of the entire vehicle industry, in particular, this type of cooperation often unleashes relevant momentum for innovation in the entire industry, not least because projects at the pre-competitive stage also offer opportunities for cooperation between competing companies.
For this reason, funding under the NFST specialist programme is only provided if there are at least two independent partners collaborating.

SMEs, the group of companies at the centre of the NFST specialist 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 R&D investments as many large R&D 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 R&D investment by building a large project portfolio. This makes them even more likely to shy away from risks.[6] 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'[7], 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 R&D investments, especially by SMEs. If the intervention is well designed, it should result in higher R&D expenditures whose positive impacts ought to outweigh the negative, both for individual companies and for society at large. Under the NFST specialist programme, small and medium-sized enterprises can receive higher rates of funding than those granted to large enterprises. The funding scheme also sets out an SME quota (30% of all funding should be used to support SMEs).

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

## Objectives of the R&D scheme

The system of objectives underpinning the specialist programme was reconstructed during the past evaluation of the NFST specialist programme. The past evaluation also includes a detailed logic model.[8] 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 specialist programme can be divided up into different layers, each using a different angle. A description of the objectives to be served by the NFST specialist programme in terms of political/strategic objectives, the objectives at programme level, and the objectives at project level can be found in the table below:

---

6 For a general outline of intervention logics underpinning SME innovation programmes seen from an evaluation angle, cf. Boekholt et al. (2014), for instance.

7 Christensen C. (1997)

8 Further explanations and images illustrating the system of objectives and the logic model can be found in the final report of the evaluation: Prognos AG. (2019). The Federal Ministry for Economic Affairs and Energy's specialist programme 'New vehicle and systems technologies'

| | **Specialist programme entitled "New vehicle and systems technologies"** |
|---|---|
| **Objectives at the overarching political/strategic levels** | 1 Boost the innovative strength of commercial companies in the vehicle industry, especially SMEs[9]<br>2 Safeguard the technological leadership role held by the German vehicle industry<br>3 Strengthen research and innovation<br>4 Promote investments<br>5 Safeguard jobs |
| **Objectives at programme level (funding measures)** | 1 Provide funding for innovations in the field of vehicles and systems technologies<br>2 Transfer research outcomes into participants' internal processes<br>3 Encourage networking between companies and between industry and science<br>4 Contribute to Germany's National Sustainable Development Strategy (SDG 9.1 Innovation)<br>5 Contribute to the fight against the repercussions of the COVID-19 crisis[10] |
| **Objectives at project level (projects)** | Objectives achieved by the aid recipients:<br>1 technology developments in the fields of automated driving, innovative vehicle concepts, and systems technologies<br>2 contributions to standardisation<br>3 greater networking between stakeholders |

Beyond this, any contribution to climate action, digitisation, or sustainability can be regarded as a horizontal objective.

The NFST specialist programme largely 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 technology leadership of the German vehicle industry. The funding provided under the NFST specialist programme is contributing to these economic objectives by increasing the innovative strength of companies in the vehicle sector through financial grants towards investments made in research and development.
The expectation is that the R&D projects receiving funding under the funding schemes will deliver innovations which can then be fed into the respective companies' internal processes, thus helping to raise their levels of productivity and competitiveness. It is therefore reasonable to expect that funding R&D projects will boost innovation within the relevant companies. This in turn can be expected to make a significant contribution to macroeconomic objectives, notably that of improving competitiveness. At project level, the funding for R&D projects is continuing to ensure job retention and/or job creation in research and development.

9 Each of the objectives is focused on SMEs as a subgroup of the entire target group. For the sake of readability, the table does not specify this for each individual point. The funding scheme specifies that 30% of the total funding ought to be used for SMEs involved in the projects.

10 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.

# Logic model

The expected benefits of the funding measures are shown in a logic model. This measures input, output, outcomes, and the impact of the funding scheme.
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 R&D projects and coordination and networking work to take place.

The output of the funding are the R&D results, publications, demonstrators, IPRs, gains in expertise, the development and testing of new procedures, skills development within the organisation or among staff, the transfer of research findings into stakeholders' internal processes, and networking taking place between companies and between business and science.

The outcome, i.e. the results achieved at the level of the target group, corresponds to the effects directly achieved the input and output. These include:

- Boosted the innovative strength of companies and facilitating marketable innovations;
- Strengthened companies' technological leadership;
- Strengthened industrial sector and improved funding for SMEs;
- Transfer of research outcomes into stakeholders' own internal process; and
- Networking between companies and between business and science.

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

- Enhanced competitiveness;
- Growth of companies in the vehicle industry;
- Contribution to the fight against the repercussions of the COVID-19 crisis; and
- Contribution to Germany's National Sustainable Development Strategy.

Support to R&D investments may lead to additional impacts as follows:

**Additionality:** Additionality is the effect that would not have occurred in the absence of the scheme. This can be in terms of investment size (e.g. more employment), scope, (not just research and development but also productive investment) or timing (e.g. quicker implementation).

**Dead weight:** If grants are targeted at marginal projects that would not have gone ahead in their absence, the scheme would be expected to lead to increases in R&D expenditure. 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 scheme.

**Displacement effects:** If an R&D 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).

**Crowding out:** This effect refers to a decrease in private sector demand as a direct result of the scheme. For example, crowding out exists if, due to the support of the scheme, less private sector R&D companies are in operation than would otherwise have been the case. The opposite effect − crowding in − would be the case if more R&D companies develop services to meet the needs.

**Substitution:** Substitution occurs where a firm substitutes one activity for another to take advantage of the scheme.

**Unintended or unforeseen effects:** These effects could be positive or negative, for example, if R&D investment facilitates the recovery of an ailing industry, leading subsequently to export growth and significant expansion.

**Wider effects**: These are effects on sustainable development through the "triple bottom line": economic, social and environmental development.

## Selection criteria and approval procedure

Companies in the commercial sector with a permanent establishment in Germany are eligible to apply under the scheme. The participation of small and medium-sized enterprises (SMEs) is expressly desired and will be positively considered in the selection decision. SMEs within the meaning of this funding scheme are companies that fulfil the requirements of Annex I of the GBER. Furthermore, universities, research institutions, associations, foundations, municipal trade associations, commercial enterprises, educational institutions, regional authorities, municipal associations and other bodies under public law with proven expertise in the field of the vehicle industry are eligible to apply. At the time of payment of the grant awarded, the existence of a permanent establishment or branch (in the case of companies) or another facility serving the activities of the grant recipient (e.g. in the case of universities, research institutions) in Germany is required.

Funding can be made available if the following conditions apply:

- Projects fit into the framework of the present programme with regard to the subject matter and the research and development objectives.
- There is a substantial federal interest in the funding (section 23 of the Federal Budget Code) that cannot be satisfied without funding or cannot be satisfied to the necessary extent.
- Projects must be technologically innovative and involve a significant technical and/or economic risk.

Applicants must have the necessary professional qualifications, sufficient human and financial resources and the basic technical equipment to carry out the project.

The projects to be funded must be collaborative projects in which at least two partners are involved. Within the framework of the collaborative projects, relevant and technologically state-of-the-art topics of research and development are addressed. The collaborative structure particularly emphasises the broad transfer of technology and knowledge. The consortium should be led by a partner from industry with a clear interest in exploiting the project results. In principle, the project result should be presented or demonstrated by a technical demonstrator. The promotion of small and medium-sized enterprises has a particularly high priority in this scheme. Therefore, the aim is for SMEs to participate (directly or indirectly via subcontracts) in 30 % of the total funding provided by the consortium. Commercial enterprises must demonstrate the incentive effect of the funding when submitting their applications. The principle applies that research and development must be carried out by the funded partners themselves. In relation to the individual funding

recipient, the scope of all subcontracts or external services should not exceed half of its own project costs.

Grants awarded under this scheme may be cumulated with other State aid, provided that these measures relate to different identifiable eligible costs, and with other State aid for the same partially or fully overlapping eligible costs, but only if this cumulation results in the highest aid intensity applicable to such aid under the GBER, or the highest aid amount applicable to such aid under the GBER is not exceeded.

Project outlines can be submitted at any time within the framework of this scheme. These are submitted to the scheme promoting agency on the deadlines of:

- 31 March,
- 30 June,
- 30 September and
- 31 December

In deviation from this, an ongoing evaluation will also be carried out outside of the specified cut-off dates in 2021. In the case of separate funding calls or announcements based on the funding scheme, the stipulations published therein are binding.

The funding procedure has two stages up to the point of approval.

First stage: Submission and selection of project outlines
Project outlines of no more than 15 pages in written and electronic form must first be submitted to the scheme pomoting agency. In the case of collaborative projects, the outlines must be submitted by the planned collaborative coordinator in consultation with the other project partners.

Description of the project idea:

- Problem description
- Novelty and attractiveness of the solution approach
- Rough project concept
- Exploitation concept
- Concept for monitoring the achievement of the project's objectives at the network level
- Potentials of the cooperation partners
- Duration and financing concept, distribution of the quantity structure among the partners

The project outlines received will be evaluated according to the following criteria:

- Programme relevance, research relevance and macroeconomic significance
- Innovation content of the proposed solution in relation to the state of the art in science and technology; differentiation from other funding activities
- Description of the technical or economic risks associated with the implementation of the project
- Scientific and economic prospects of success of the project or its subprojects (e.g. chances of market penetration, transferability of results)
- Application-oriented validation and practical demonstration of the results
- Exploitation concept
- Coherence, appropriateness and efficiency of work and project planning
- Efficient and manageable project organisation

- Monitoring of the project's achievement of objectives at the network level
- Participation of SMEs

Project outlines compete with each other in each programme pillar.

On the basis of the evaluation, the scheme promoting agency selects the project ideas that appear suitable for funding at its own discretion.

Second stage: Submission of formal applications for funding and decision-making procedure
In the second stage of the procedure, interested parties with positively evaluated project outlines are invited (in the case of collaborative projects, in consultation with the planned collaborative coordinator) to submit a formal application for funding, on which a decision is made after final review. If the available budget funds are not sufficient to fund all positively evaluated projects, the funding applications will compete with each other. Using the above criteria, priorities are set, if necessary with the involvement of external experts. The scheme promoting agency shall make its decisions at its own dutiful discretion. The award of the grant is subject to the availability of the budgeted funds.

## Evaluation questions and indicators

The evaluation will consist of examining the effects and impacts of the funding based on the funding scheme for the NFST specialist programme. The plan is to use the results of the evaluation to further develop the funding programme and make any adjustments required, should the funding scheme be extended beyond 2024. The targets and the impact of the funding on recipients' actions ought to be measured on the basis of reliable statistical data. 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: whether the aid has caused the beneficiary to take make (additional) R&d investments, and how significant was the impact of the aid on the investment behavior? It is also worth studying whether the effects differ for companies of different sizes.
The scheme aims to trigger positive spill-over effects like knowledge spillovers and the development of the company networks. These indirect impacts can have an impact on the whole sector, on several other sectors or even on the whole economy. The future evaluation should address and examine if there are any indirect effects of the scheme. The future evaluation should also strive to to examine sub-groups, e.g. according to particular types of business, size or project type. This will make it possible to map heterogeneous funding effects.

The evaluation questions are to be answered with the help of suitable indicators. These must factor in that some impacts of the funding will not materialise until after some delay, which means that some data on certain effects will not become available during the evaluation period. It will be difficult to estimate results and impact indicators, given that a reliable means of proof requires the use of analytical and quantitative methods, which can only be used to a limited degree because of the time-related restrictions.

The following specific evaluation questions and specific result indicators will be considered to quantify the impacts of the scheme.

| Evaluation question | Indicator | Source | Frequency | Level | Population |
|---|---|---|---|---|---|
| Has the scheme as a whole boosted the innovative strength of commercial companies in the vehicle industry, | Innovation indicator(s): new products and | Survey, interviews | Irregular | Sector | All firms |

| | | | | | |
|---|---|---|---|---|---|
| especially SMEs? | services, new processes | | | | |
| Has the scheme as a whole safeguarded the technological leadership role role held by the German vehicle industry? | Innovation indicator | Survey, interviews | Irregular | Sector | All firms |
| Was it possible to achieve an initial effect?<br>Has the target population of SMEs received the aid?<br>Have companies that used to have lower rates of R&D expenditure increased their R&D efforts?<br>What was the impact of the widened scope of the scheme (‘systems technologies’, feasibility studies and others)? | Indicators of implementation: number of projects supported and funding volume<br>Number of “system technology” projects and feasibility studies<br>First time R&D activities<br>R&D expenditure of companies with a record of low R&D expenditure | Scheme promoting agency | Quarterly | Firm level | Aid beneficiaries |
| Has the scheme strengthened research activities?<br>Are the projects that have received funding resulting in a rise in R&D activities?<br>Is there a difference in the development of R&D expenditure between companies that have received funding and other comparable companies? | R&D expenditure<br>Distribution of R&D expenditure for companies of different sizes<br>R&D staff<br>Employee skills | MIP, additional micro data (tentative) | yearly | Firm level | All firms |
| Has the scheme promoted investment?<br>Does investment behaviour differ between funded and comparable non-funded enterprises? | Amount of and changes in investment expenditure | MIP, additional micro data (tentative) | yearly | Firm level | All firms |
| Has the scheme safeguarded jobs?<br>Does employment differ between funded and comparable non-funded enterprises?<br>Has the funding contributed to a short-term increase in jobs or to jobs being retained (employees working directly in the R&D departments of recipient companies)? | Development of staff numbers as a direct effect of the funding (not the long-term impact resulting from better competitiveness)<br>Number and changes in R&D employment | MIP, additional micro data (tentative) | yearly | Firm level | All firms |
| Has the scheme encourage the transfer of research outcomes into participants’ internal processes? | Changes in processes | Own survey, interviews | Irregular | Sector | Aid beneficiaries |
| Has the scheme encouraged networking between companies and between industry and science? | Initialisation and consolidation of R&D cooperation | Own survey, interviews | Irregular | Sector | Aid beneficiaries |
| Has the scheme encouraged greater networking between businesses? | Initialisation and consolidation of R&D cooperation | Own survey, interviews | Irregular | Sector | Aid beneficiaries |

| | | | | | |
|---|---|---|---|---|---|
| Has the funding helped build skills and know-how within the companies?<br>Have companies receiving funding made more inventions and patent applications in the field of vehicle and systems technology than other companies? | Number of inventions, IPR or patent applications | MIP, additional micro data (tentative) | yearly | Firm level | All firms |
| Has the scheme had positive spill-over effects on the activity of other firms?<br>How do these differ between companies of different sizes? | Productivity trends | MIP, additional micro data (tentative) | yearly | Sector | All firms |
| What negative indirect effects (if any) did occur during promotion and are there any special features? | Displacement of activity | Own survey, interviews | Irregular | Sector | Aid beneficiaries |
| Was the scheme proportionate and appropriate to the problem being addressed? | Qualitative questions | Own survey, interviews | Irregular | Sector | All firms |
| Could the same effects have been obtained with less aid or a different form of aid? | Qualitative questions | Own survey, interviews | Irregular | Sector | All firms |
| Was the most effective aid instrument chosen? | Qualitative questions | Own survey, interviews | Irregular | Sector | All firms |
| Would other aid instruments or types of intervention, including non-aid options, have been more appropriate for achieving the objective in question? | Qualitative questions | Own survey, interviews | Irregular | Sector | All firms |
| Is there a need to redefine the objectives and/or the target beneficiaries to achieve the same policy objectives? | Qualitative questions | Own survey, interviews | Irregular | Sector | All firms |

These questions ought to be studied using a mix of methods of an analytical and quantitative nature. The evaluation will help assess whether the selected funding instrument is appropriate and therefore pick up on any freeriding, which would be classed as a highly important negative effect.
Furthermore, the evaluation can also use a different set of methods to cover additional issues, e.g. to what extent do the funding projects make a contribution to Germany's National Sustainable Development Strategy? What are the contributions to standardisation by the funding?

## 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 of the scheme.
The proportionality will be examined by comparing R&D trends and actual take-up of R&D projects and investment, and the number of beneficiaries withdrawing or abandoning a R&D project.

The future evaluation will look at:

- Was the R&D scheme 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?

# Main assumptions and potential issues of the evaluation

The future evaluation will help gather additional information about the way in which the NFST specialist programme works, measure the success of the programme, and shed light on potential further improvements to be made, as the Federal Government plans to continue the specialist programme even after the measures under the Stimulus and Future Packages will have expired. The future evaluation will take into consideration results of the previous evaluation and the special features of the revised scheme. This evaluation plan will consider the special features of the NFST specialist programme so that the future evaluation will address them.

At its core, the NFST specialist programme is an industry-specific aid measure in the sense that the research and development measures taking place in the pre-defined priority areas are largely restricted to the automotive and railway industries and are designed to foster technology development and support the industrial sector. It has to be borne in mind, however, that the funding scheme does not exclude any company from funding on the grounds of the industry it belongs to. This means that it is possible for companies outside the vehicle industry to be involved in a collaborative project so long as the overall project serves technology development in the vehicle industry. Funding is therefore also available to companies working in ICT, mechanical engineering, the chemical industry, and other sectors. Given the call for fundamental structural change in the vehicle industry, the involvement of stakeholders that do not belong to this industry is regarded as an important push for innovation.

## Heterogeneity of companies and projects

There has been a wide range of different sizes of projects that have received funding under the scheme, from small projects receiving no more than €1 million and involving just a few partners up to large projects receiving more than €20 million and having more than 20 partners. This bipolar funding structure is to be continued in the interest of addressing the technological challenges ahead. It is possible that future large projects receiving funding under the programme may be even larger in size, given the pressure to transform. At the same time, small collaboration projects focused on specific niche innovations are also important. Larger projects often serve as flagships, having a strong impact on the sector at large. By contrast, the reach of smaller projects tends to be smaller, but these are often focused on highly relevant innovation issues having a strong leverage effect on the companies concerned.
The evaluation of the scheme will addresses a broad range of different R&D projects. 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 R&D projects (larger and smaller projects).

The scheme is an application-oriented funding programme (with projects usually achieving technology readiness level 7), but all projects are required to be associated with a considerable technical and economic risk, so as to ensure that the funding on offer truly serves as an incentive.

Due to the complexity of the projects receiving funding, there is a possibility that they may fail to reach their intended outcome. It is the job of the administrators and the providers of the funding to take this risk into account during the various funding phases of a project (application, monitoring during implementation, and final verification of success at project level) and to take action if necessary. The complexity of a project's objectives, however, is unique to each case.
This means that, even though there is a sector-specific and technological focus, it is likely that there will be heterogeneous funding effects, especially following the widening of the programme in 2021. Wherever possible, the evaluation ought to take account of the complexity of individual types of projects as part of the impact analysis.

Statistical models for impact often assume a standard 'normal' distribution of observations around a mean. However, the impacts of R&D investments tend to be skewed towards a smaller number of very successful projects and many low to medium impact projects. This profile of impacts 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.

The 'profi' aid database allows for an analysis of the spectrum of aid recipients in 2020 (ongoing projects and projects starting in 2020).[11] In 2020, there were 431 aid recipients involved in 64 collaborative projects, 22.5% of which were SMEs, 46.2% large companies, 30.9% higher education institutes or research institutions, and the rest federal, regional, or local authorities or other public-sector bodies. If subcontracts are factored in (as is specified in the funding scheme), some 30% of the total funding goes to SMEs.
After the start of the programme in 2015, the funding scheme was amended once (in 2018), not least with a view to fostering cooperation between commercial companies and higher education institutes and other research institutions by offering higher rates of funding, thus promoting collaboration between business and science.

The 2021 amendment (cf. details above), which is subject to the future evaluation, introduces new priorities in terms of content/substance. It also makes it possible to offer funding rates of up to 80% to SMEs (in line with GBER), so as to motivate companies to tackle innovation and get involved in the programme in higher numbers even in the challenging economic environment of the COVID-19 pandemic. It seems reasonable to expect that this amendment of the funding scheme will have an impact on the intended effects and impacts of the aid measure, an expectation that should give rise to analysis as part of the evaluation.

## Duration and lagged effects

The duration of the projects receiving funding is of special importance to the evaluation's timeframe. With only a few exceptions, the regular duration of the projects receiving funding under the NFST specialist programme is 36 months. Unlike investment projects, for instance, the projects here need a comparatively long time to achieve their full impact. The funding is disbursed individually and at individual times, in line with the progress made. Once a project has been completed, it usually takes several more years to bring the outcomes achieved with the help of funding to market readiness (technology readiness level after the end of the project tends to be TRL 7). This is in the interest of pre-competitive collaborative research and the scrutiny of application also includes checking that there will be no immediate commercial exploitation of the project outcomes after the end of the project. The findings from the 2019 evaluation confirmed that

11 There might be significant changes compared to the external evaluation that was completed in 2019, given that that external evaluation only covered R&D projects from before 2019. It was found, for instance, that the share of SMEs involved in the programme had risen considerably since the launch of the programme in 2015.

further time for development is needed after the end of the project before outcomes can be commercially exploited: 52% of the companies surveyed stated that they would need another two to three years to reach market readiness, compared to only 11% estimating that they would get to this point within a year after the end of the project. For this reason, the long-term impacts of the funding measures (e.g. on turnover and job retention) can be expected to materialise no sooner than three years after the end of the project, which is six years after the beginning of the project. This is not the case, however, for direct effects such as R&D spending or networking between companies, which can be expected at an earlier time. It is therefore important to bear in mind the delays in effects and impacts when designing the evaluation.

## 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 R&D projects 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 R&D investment. 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 R&D investment being used to explain long-term 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 capacity to use and adapt research results done by other companies or research institutions. This capacity could affect a company's likelihood of applying for an R&D scheme, and could also affect that company's long-term performance. If adaptation capacity 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 R&D, innovation and performance, and that the observable characteristics – such as the age, size, or sector – of a company only explain a small part of R&D 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 scheme (intervention) not occurred. Gross impacts need to be adjusted to discount for what would have happened anyway. The evaluation will estimate impact of the scheme by using control groups. However, additionality and deadweight are not straight forward, and headline numbers need to be treated with some caution.
Beyond this counterfactual, there are wider effects to consider in the evaluation.

- Displacement: where positive outcomes of the scheme are offset by negative outcomes elsewhere. For example, where the project supported by the scheme leads to an increase in the company's market share due to new products and processes, other companies might see their market share reduced.
- Substitution: where the effects of a scheme are realised at the expense of other activities. For example, where the scheme triggers R&D investments at the expense of an alternative R&D project, which could also have positive outcomes.
- Knowledge diffusion: where beneficiaries of the scheme develop new knowledge and then move on and apply it to other projects not associated with the project or company. These spillover benefits are generally found to be large – often larger than the direct benefits of the R&D support, see Department for Business, Energy and Industrial Strategy (2015). For this scheme, BMWi assumes that there will be substantial spill-over effects.

# Envisaged evaluation method and appropriate comparison group

The causes of the effects achieved by the aid delivered through the NFST specialist programme are to be measured with the help of various methods; the results are to be used as input on how to further improve the programme. The 'Common methodology for State aid evaluation'[12] published by the European Commission shows that the focus of the evaluation needs to be on the use of analytical and quantitative measures that are able to capture the effects caused by the funding itself, free from any distortions resulting on other variables. The Common methodology suggests that quasi-experimental methods seem best suited to demonstrating the causal effect of the intervention in the context of the design and the parameters of the funding programme.[13] Quasi-experimental methods are used in many evaluations with econometric applications.

The future evaluation of the NFST programme will try 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. 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 suitable R&d project to begin with, whereas the second did, i.e. the management of the former group are lacking any willingness or need to enter R&D activities.
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.

12 https://ec.europa.eu/competition/state_aid/modernisation/state_aid_evaluation_methodology_en.pdf

13 In view of the funding process, randomised or natural experiments are not possible in the existing NFST specialist programme. A structural estimate with a complete theoretical model does not seem appropriate in view of the complexity of R&D funding and the expected long-term effects.

The NFST programme has been evaluated[14] and there were some 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. The 2019 evaluation of the NFST specialist programme drew on a set of methods including case studies, surveys of recipients, patent research, and research in literature. Analytical and quantitative methods were not used to the extent that would be expected by the European Commission according to its 'Common methodology for State aid evaluation'. Because of this, a suitable set of methods for the next evaluation is being prepared, even though the NFST specialist programme is a complex case in terms of the integration and application of analytical and quantitative methods.

In order to measure the causal effect, i.e. the difference between the outcome with State aid and without State aid, it is necessary to use micro-econometric methods which exclude the distortive effect of other variables on the outcome to be measured. When such methods are applied to funding programmes, the design of a counterfactual situation presents a challenge. The aid recipients (the "treatment group") need to be compared with a control group. This is because, by definition, the effect without funding cannot be demonstrated by studying only the beneficiaries. However, a simple comparison between recipients and non-recipients is not helpful, because the characteristics of the compared groups are similar and non-observed external variables need to be largely excluded. In the past, various methods have been applied to funding programmes. The choice of method to measure the effect and to compile the control group, in conjunction with the availability of data, therefore plays a great role in the evaluation.

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 is 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. Patent and literature research, 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, if feasible, 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 and the use of external expertise. The findings gained should contribute in particular to the further development of the NFST specialist programme in the run-up to a potential extension of the intervention beyond 2024.

Consideration should be given to an elaboration and further development of the existing ideas about evaluating R&D projects for the new feasibility studies introduced in 2021 in the NFST specialist programme. The budget allocated to these will very probably only be a minimal share of the totality of all funded projects. Nevertheless, the effects and impact of the funding of feasibility studies, which are likely to involve a higher proportion of research, should be studied with regard to the

14 Prognos AG. (2019). The Federal Ministry for Economic Affairs and Energy's specialist programme 'New vehicle and systems technologies'

goals of the intervention and with regard to the extent to which this instrument serves to assist companies.

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).[15] 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.

Instrumental variables is a another method for evaluating interventions and, in particular, to deal with endogeneity of explanatory variables. This method could be useful for the R&D programme, however, the additional selection through the selection application process make the method less suitable. The selection process of the R&D scheme will most likely withhold interventions from some businesses.
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 R&D activity, i.e. a simultaneous requirement of "participation determination" and "non-influence on the outcome of participation".

Regression discontinuity design is another possible method that the future evaluation methods should take conceptually into account. Companies might be rejected for project funding to a given measurable criteria either at stage one or two. This cut-off determines their participation in the scheme. Idealy, companies just above the cut-off are compared to non-participants just below. However, there is no real cut-off threshold in the selection process, but the companies that passed stage one but not stage two could serve for this purpose in a regression discontinuity design. Moreover, the measured effect is only "local", meaning that it holds only for the companies close to the cut-off. BMWi recommends that the future evaluation should examine the use of regression discontinuity methods, and if feasible, to apply this method to evaluate the impact of the scheme.

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

A customary method for R&D funding measures is to apply the Conditional Difference-in-Difference procedure.[16] This combines two methods: the Difference-in-Difference procedure to monitor for unobserved characteristics, and a matching procedure to select the control group, i.e. to monitor observed characteristics. Consideration should also be given to whether the Conditional Difference-in-Difference procedure can be used in the evaluation of the NFST specialist programme. It is necessary to consider whether the procedure can deliver robust estimates given the parameters (funding programme design and data availability).
The method can be used for this R&D scheme 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 R&D scheme the funded projects have a fairly specific purpose, and might involve the largest companies in the sector. Therefore, there is a risk that matching on observables might no lead to disentangle the two groups of funded and non-funded companies.

In the course of the evaluation, the extent to which further analytical methods can be deployed should be examined. The plan is that bidders should be given the possibility to propose further methods when the evaluation contract is awarded.

The quality of the control group is of crucial importance for the measurement of the causal effects. Here, it is necessary to use the best possible control group of non-recipients in order to build the counterfactual case. It is difficult to draw a precise line between recipients and non-recipients and thus between the treatment and control groups. The definition in the working document 'Common methodology for State aid evaluation' states that the control group must not consist of companies which have voluntarily decided not to benefit from the intervention. The membership of the control group should not influence the measured results. In the NFST specialist programme, which, for instance, does not have any exclusion criteria for certain regions or company sizes, the strict definition cited here mainly refers to companies which do have a corresponding project, but whose application was rejected. The assessment, i.e. the approval or rejection, of an application for funding is the result of a detailed assessment process by the managing authority. This means that, assuming sufficient funds are available, one reason why an application for funding has been rejected can be the poor quality of the project and/or the lack of expertise and/or a lack of financial capacity in the company, and this can in turn influence the observed outcome. Another possibility is that the companies are unaware of the NFST specialist programme. Also, companies may make the false assumption that their project does not fit the conditions of the NFST specialist programme (asymmetry of information). Since funding can only go to collaborative projects involving at least two legally separate partners and there are strict requirements regarding the participation of SMEs in the project, companies might also not receive funding because they have been unable to find a project partner or do not meet the requirements for a collaborative project (highest possible involvement of SMEs, not a higher education institution as leader of the consortium, not at least two legally separate project partners). However, it is not possible to filter these sub-groups of non-funded innovators from the totality of non-funded innovative companies. This means that there is always a certain degree of selection bias. In order to counter this selection bias, it is necessary to undertake a suitable and comprehensive selection of variables in order to match the groups to be compared.

16 Examples of applications are described in Görg und Strobl (2007) regarding R&D funding in Ireland, Marino et al. (2016) for an analysis of the French R&D tax credit) or Kaufmann et al. (2019) for the ZIM R&D funding programme of the Economic Affairs Ministry.

It is expected that the answers to the evaluation questions will necessitate special consideration with regard to large companies from the vehicle industry (a sub-group of the treatment group). 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 on R&D, which can make it harder to undertake a matching procedure, irrespective of data availability. 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.

It can be assumed that all the very large companies in the vehicle industry are aware of the NFST specialist programme. Also, many of these will be involved multiple times in different projects receiving funding under the NFST specialist 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 (surveys, interviews, workshops) can usefully supplement the mix of methods. Irrespective of the quasi-experimental methods used, the quality of the evaluation depends on the quality of the available data (see below). The minimal preconditions for the application of the Conditional Difference-in-Difference procedure are met.

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 R&D activity,
- Employment,
- Labour productivity,
- Sales and/or profit,
- Investment and R&D expenditure pre-intervention.

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, survey 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

The success of the evaluation will much depend not only on the choice of method, but also on the quality of the data sources. This is why the best possible sources are to be used. The following is an outline of the planned collection and use of the necessary data.

## General data availability

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 administrators of the funding 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 project managers include the field of technology, project volume, amount of funding, and statements made by the aid recipient on incentive effects and technology readiness prior to and after the project, all of which are data collected as part of the standard application process and during project implementation. Most of these company-specific and project-specific data are gathered in the project funding information (profi) system. Beyond this, however, some basic data of the companies whose project outlines or applications have been rejected are also recorded, meaning that there are some data on these companies. A compilation of these data is published in the annual report made by the project managers, which, in 2019, served as the basis for the external evaluation of the NFST specialist programme.

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 evaluating an R&D funding programme, 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 and, in particular, the Conditional Difference-in-Difference procedure. 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:[17]

17 Christensen et al. (2014)

- Educational level of the company's employees
- R&D intensity
- R&D department (number of employees working in R&D)
- Export intensity
- Investments in R&D
- Profit, surplus, or contribution margin
- Company size (number of employees)
- Industry affiliation

The use of too many explanatory or too many identical variables 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)[18] is being given special consideration and scrutiny. Its set of variables goes beyond the minimum requirements (e.g. R&D cooperation, sites etc.) to include 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 NFST specialist programme, are included in the Mannheim Information Panel.

The following variables will be also included in the evaluation in addition to the above (necessary minimum):

- Turnover
- Innovation output (product and process innovations)
- Labour productivity

This defined set of variables has been selected to be used in the evaluation.

Additional and optional variables for the evaluation should be considered:

- Spending on innovation
- Spending on investments (investments in material assets, ICT investments)
- Share of sales from product innovations and market innovations

## Use of an external database

The Mannheim Innovation Panel (MIP), which is part of Eurostat's Community Innovation Survey with the Leibniz Centre for European Economic Research (ZEW) as Germany's contribution, is based on an annual survey in writing of more than 6,000 companies employing more than five staff and of another annual survey by telephone of more than 6,000 companies. The questions asked revolve around various core indicators[19] measuring innovation activities. It is reasonable to expect that most of the companies receiving funding under the NFST specialist programme are captured by the MIP. Companies employing fewer than five staff usually do not receive funding under the

18 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/

19 More information on the core indicators is provided by the Leibniz Centre for European Economic Research in Mannheim at: https://www.zew.de/publikationen/zew-gutachten-und-forschungsberichte/forschungsberichte/innovationen/innovationserhebung/kernindikatoren

NFST specialist programme as they lack the manpower and financial capacity required for a project that would meet the requirements (pertinent research etc.).
Every two years, a new, random sample is added to the data set used for the MIP, e.g. to replace companies that no longer exist. The panel data (data over time and across different sectors) are necessary for monitoring companies over a longer period of time and for measuring dynamic effects on R&D investments. A method that would disregard the variation of companies' investment behaviour over time, e.g. an analysis based on a simple data set dating back to the time before the funding and another from a year after receipt of the funding, would be insufficient.

Compiling a data set for the evaluation requires linking up data from the administration side (data held by the project managers) with the external database. For this purpose, it makes sense to use unique identification numbers, such as the ones used by creditworthiness rating agencies or the trade register. Project managers 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 project managers. The Federal Ministry for Economic Affairs and Energy can then ask that the data sets be linked up with one another.

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 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 also be 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.

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 and the scheme promoting agency plan to run an own survey with beneficiaries and scheme managers, to regularly

use case studies and regularly conduct interviews. The exact timing and frequency will be decided between BMWi, the scheme promoting agency and the independent evaluation body. 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

As was explained above, the regular duration of projects under the NFST specialist programme is 36 months. This means that, by the end of the evaluation, those R&D projects that started in the first half of 2021 after the adjustment of the scheme will not or will only just have been concluded. The data from the surveys conducted by the Mannheim Innovation Panel, the external source of data, will be available at the end of each year (with surveys taking place in the middle of the year), which means that there will be no external data for 2024 available in time to be fed into the evaluation.
Given the time frame of the R&D projects that started after the adjustment of the scheme, the focus here will be on output indicators. Furthermore, R&D projects that started in 2020 are also to be covered by the analysis, which will help improve the database and, ideally, also help study those effects of the funding that only materialise after a project has ended. It is true that the amended scheme was not in force at the time, but as the underlying funding concept has remained unchanged, the positive aspects of including additional funding projects in the analysis should outweigh the negative.

The notification of amendment of the funding scheme for 'New vehicle and systems technologies' entered into force in March 2021, with the new funding scheme, which has a broader scope in substance and a larger financial envelope, applying until 31 December 2024 (subject to the extension of the GBER beyond 30 June 2024). If a new GBER comes into force or if there are any similar changes to aspects of the State aid rules, the evaluation plan would be adjusted as necessary as part of a flexible response to this.

To address this issue, the evaluation plan suggests that the evaluation is designed to span a wide time frame, using insights from the existing evaluation and planned studies covering projects starting before the revised scheme. The evaluation plan proposes a final evaluation by June 2023 to assess initial impacts and the viability of the evaluation methodology. The final evaluation will also propose, if needed and conclusion are robust, an adjusted evaluation method to cope with the new needs. It is very likely that many of the impacts cannot yet be captured by the final evaluation due to the long time-lag of the interventions and insights of the evaluation might not be fully conclusive. The final evaluation will therefore also serve as a stepping stone to continue the scheme and its further evaluation beyond 2023. In case of non-conclusive insights and/or lack or robustness of evaluation insights, the Ministry for Economic Affairs and Energy is committed to continuing its evaluation efforts and submit an additional report by 2026 that will include the an evaluation of the scheme.

The call for bids for the evaluation contract is to be placed in Q3 of 2021 and the evaluation itself to be designed to complement the funding programme in a way that allows for synergies with other steps and measures to be taken in support of the programme (e.g. research into the Stimulus and Future Packages as a whole)[20].

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

20 Good places for this would be following websites created by the Federal Ministry for Economic Affairs and Energy: www.kopa35c.de, www.fahrzeugtechnologien.de, and www.evaluationen-bmwi.de.

committee, and the state of implementation. 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.

# Independence of evaluation and publicity

BMWi will ensure that the evaluation of the impact of the R&D 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 and will be undertaken by an independent body. 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 evaluation and 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 R&D programme.

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 R&D interventions.

# References

Christensen C. (1997). The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail. Harvard Business Review Press

Christensen T. A., Frosch H., Boysen-Jensen D. (2014). Central Innovation Manual on Excellent Econometric Evaluation of the Impact of Public R&D investments “CIM 2.0”. Danish Ministry of Higher Education and Science, Copenhagen

Görg, H. and Strobl, E. (2007): The Effect of R&D Subsidies on Private R&D, Economica 74(294), May, 215-234

Marino, M., Lhuillery, S., Parrotta, P., and Sala, D. (2016): Additionality or crowding-out? An overall evaluation of public R&D subsidy on private R&D expenditure. Research Policy 45(9), 1715-1730

Kaufmann, Peter, et al. "Evaluation des Zentralen Innovationsprogramms Mittelstand (ZIM): Richtlinie 2015; Endbericht." (2019).
Prognos AG. (2019). The Federal Ministry for Economic Affairs and Energy’s specialist programme ‘New vehicle and systems technologies’

European Commission (2014). Common methodology for State aid evaluation. Commission Staff Working Document, SWD(2014) 179 final, GD Competition, Brussels