Policy Relevant Sustainability Research

Requirements Profiles for Research Funding Agencies, Researchers and Policymakers Regarding Improving and Ensuring Quality of Research – A Guide

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Freie Universität Berlin

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UMWELTBUNDESAMT

The contents of this publication do not necessarily reflect the official opinions.

Contents

Note on the English Translation:

The actor-specific requirements profiles for a policy relevant sustainability research presented in this guide were developed in the context of the German science system. Some aspects addressed by the profiles or certain technical terms can thus not readily be transferred to other countries. However, the authors believe that for the most part the profiles can provide useful guidance for actors on the international level as well.

Tips on Using this Guide

Research aimed at helping to solve pressing societal problems must meet specific quality requirements: The knowledge it produces must not only be sound but also useable. This is particularly true of research that aims at bringing specific knowledge to bear on policy issues relating to sustainable development. This guide provides detailed actor-specific requirements profiles for this type of "policy relevant sustainability research."

This guide is aimed at research funding agencies and contracting entities, researchers and policymakers[1] who participate directly in the research process. It can be used both for cases where the research funding agency/contracting entity and the policymaker are different institutions or where they are identical. However, policy consulting by specialized agencies that do not perform original research is not addressed.

The requirements profiles serve two functions. First of all, they should function as a guide for the three stakeholder groups, aiding them in their efforts to increase and ensure the quality of research processes and research outcomes. And, secondly, they should improve the reflexive communication among stakeholders regarding the means and the goals of research.

The principle of open-endedness also applies to policy relevant sustainability research. Orienting research in line with non-scientific quality requirements, however, harbors the risk of putting this principle in question. The requirements profiles presented here, therefore, should not be seen as demanding a standardization of research processes or as a "check-list" to be followed systematically. Instead, the extent to which they are used during the initiation, execution and implementation of research must be decided case-by-case.

Adhering to additional quality requirements involves costs, both in time and money, for everyone involved, but especially for researchers. But not all research projects can afford such costs. This guide, therefore, is above all aimed at policy relevant sustainability research projects with the following characteristics:

- Participation of at least two research institutions (or two departments within one institution) with different disciplinary orientations and one policymaker as partner;
- research personnel resources consisting of at least 24 person months and a total duration of two years or more;
- an expressed demand on the part of the research funding agency or contracting entity for research aimed at application or implementation;
- resources specifically earmarked by the research funding agency or contracting entity for the implementation of additional quality requirements.

In what follows, first the concept and empirical basis for the development of the requirements profiles are presented. Following that, so called key requirements are characterized. The key requirements should allow for a wide applicability of the requirements profiles and also offer guidance to research projects that do not entirely meet the characteristics introduced above. The complete catalogs of requirements for research funding agencies/contracting entities, researchers and policymakers is presented in the last section. Information on the research project that was used to develop this guide, along with acknowledgments, can be found at the end of the document.

The "Great Transition" into sustainable development presents a challenge for the whole of society. Evidence-based policymaking is one important, but in no way the only, area of action for meeting this challenge. The focus here on policy relevant sustainability research is not meant to question this insight but, rather, to put it into practice. Science interfaces with different sectors of society. Making such interfaces more permeable for the transfer of knowledge means translating their particular features and functions into specific requirements for the actors involved. This guide performs this task for the interface between science and policymaking.

1 Introduction

"Sustainability Research" or "Sustainability Science" has become a common term, one found in the names of research programs, research institutions and specialist journals. But just like the term "sustainability" itself, "sustainability research" is not clearly defined. One finds included in it activities as diverse as, among others, investigating arctic ice cores for understanding climate change and devising concepts for sustainable municipal public transportation and traffic systems.

What is clear among this diversity is that sustainability research is concerned with problems that transcend disciplinary boundaries. Such problems are characterized by the fact that, in addition to raising complex scientific issues, they also represent a pressing need for societal action. This leads to quality requirements on research that go beyond the traditional scientific understanding: Sustainability research must not only provide *well-founded* knowledge but *usable* knowledge as well.

Until now, there have been no elaborated, commonly accepted, actor-specific requirements profiles for sustainability research. Such profiles are needed to support research funding agencies, researchers and stakeholders from civil society, business, administration, and politics in facilitating research aimed at providing transferable scientific knowledge that can increase our capability to deal with sustainability problems. This lack is no doubt part of the reason for the observed phenomenon of excellent research results failing to move across the border between science and society.

This applies in particular to research aimed at providing advice on sustainable development policy issues. It is for this type of "policy relevant sustainability research" that the detailed actor-specific requirements profiles that follow have been developed. The goal is to provide guidance to research funding agencies/contracting entities, researchers and policymakers so that they can improve the quality of research and their communication with one another. To this end the profiles focus on the particular challenges arising in interdisciplinary and transdisciplinary research.

The scientific quality standards and criteria already in place provide for excellent research. What is now needed in the context of sustainable development are additional, generally accepted quality criteria that better foster research relevant for society and policymaking. Such criteria create procedural reliability and thus contribute to simplifying and disburdening research processes for all participants – something that non-binding requirements can only achieve to a limited degree.

This guide may be understood, then, as a first step in the development of generally accepted, enhanced quality criteria for sustainability research (see also page 13). It was designed specifically as a "learning document:" practical experience gained in applying it will contribute to both the continuous improvement of the requirements profiles and to the development of future projects aimed at developing quality criteria.[2]

2 Comments and suggestions concerning this guide would be greatly appreciated. Please send them to: feedback-nf@uba.de.

2 Concept for Developing the Requirements Profiles

Definition of Sustainability Research

The starting point for developing actor-specific requirements profiles for a policy relevant sustainability research is the following general definition of sustainability research:

> *Sustainability research is directed at concrete problems in the context of sustainable development, without being limited by disciplinary boundaries and with the aim of producing and communicating methodically founded knowledge that increases society's ability to deal with such problems.*

This definition is consistent with a widely shared basic understanding of sustainability research (or "sustainability science") found in both the international academic discourse and the science policy discourse (see page 33). Initially, with the help of this definition, nine requirements dimensions were identified that apply to any kind of sustainability research (see Table below). These requirements dimensions are also consistent with a firmly established basic consensus found within the relevant international expert discourse (see page 33).

systemic	scale spanning	prospective
understanding of social-ecological systems, including feedback effects and temporal inertia	consideration of different spatial and social scales and of transition effects	consideration of alternative development paths, critical thresholds and surprises
context specific	**integrative**	**method-based**
relation to concrete problems and their respective action and behavioral contexts	integration at epistemic, social-organizational, communicative and technical levels	understandable and transparent production, integration and evaluation of knowledge
critical-reflexive	**normative**	**impact oriented**
uncertainty, lack of knowledge, cognitive boundaries, impact assessment, role understanding	maintaining the viability of societies, attention to current and future issues of justice	applicability and feasibility, increased capabilities for action, safeguarding knowledge

Table: General requirement dimensions for sustainability research.

General Approach to Developing the Requirements Profiles

For the purpose of this guide three areas are distinguished in which research can contribute to raising society's action capabilities with respect to sustainable development: "policy relevance," "societal relevance"[3] and "scientific relevance." The nine requirements dimensions introduced above can be translated into concrete requirements profiles for the different actors within each of these three areas (see figure on page 10). For the area of policy relevant sustainability research this translation is provided in the following.

By distinguishing fundamentally among these three areas the broad spectrum of sustainability research can be covered. Thus, climate research into ice cores can be treated as sustainability research which is primarily aimed at new scientific knowledge. Research, on the other hand, into the spread of sustainable consumption patterns within given population groups is aimed more at social innovations. Finally, research that helps municipalities in formulating and evaluating climate protection strategies is, at its core, concerned with contributing to innovative policy-making.[4]

Research practice often displays close relationships between the three areas. So, for example, in most cases it is hardly possible to formulate a sensible and effective strategy for increasing municipal energy efficiency if the need for changes in consumption and use patterns is not addressed. Thus, the distinction made here between the three areas is not to be taken as a sharply defined classification. Rather, it should be seen as pointing to the insight that, depending on the main lines of research, specific requirements must be met by the various actors involved in order to achieve effective results – an insight drawn from the evaluation of numerous research projects (see page 11).

As shown in the example above, one can assume that many of the requirements proposed for the area "policy relevance" in the following can also be applied to the area of "societal relevance." But this cannot be as readily presupposed regarding the area of "scientific relevance." When working out individual requirements profiles for societally or scientifically relevant sustainability research – which are not covered in this guide – the question of range of application needs to be more closely investigated.

3 "Societal relevance" refers here to demands made on sustainability research in areas such as economics, health, law, engineering, consumption and civil society.

4 The report "World in Transition – A Social Contract for Sustainability" published by the German Advisory Council on Global Change (WBGU), where terms such as "transformation research" and "transformative research" may be found, is a first step towards systematizing this discussion. While the former term refers to studies of transitional processes within social-ecological systems, the latter refers to studies aimed at contributing to shaping and enabling these transitions.
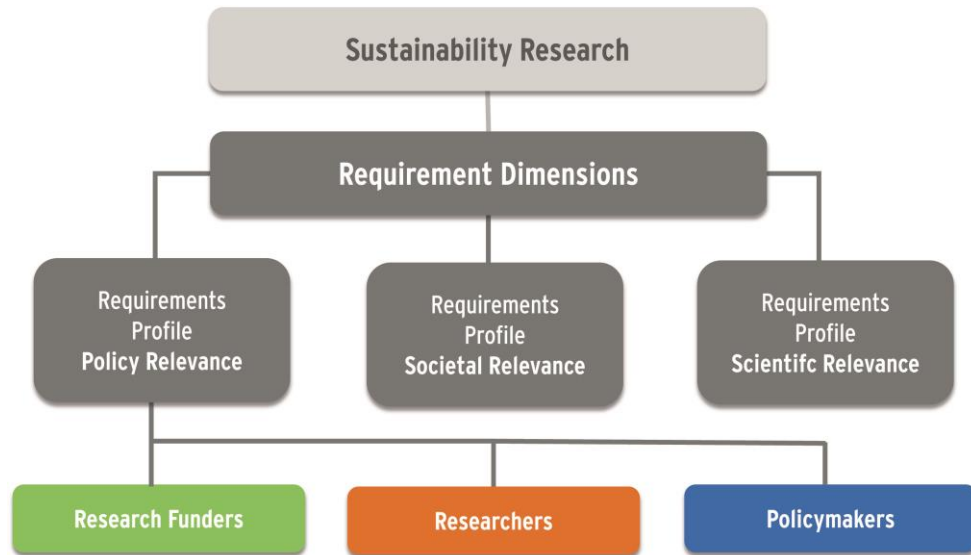
Figure: Diagram of the development of requirements for a policy relevant sustainability research. The diagram does not represent a structure of responsibilities for dealing with problems relating to sustainable development. Its function is to support the development of specific requirements for different types of sustainability research.

Function of the Requirements Profiles

5 In the development of the requirements profiles research funding has been used as the main model, but its application to contract research is clear. The profile, therefore, adresses both funding agencies and contracting entities.

The requirements profiles for policy relevant sustainability research presented here are directed towards funding agencies or contracting entities[5] of such research, as well as researchers and policymakers. The requirements are meant to provide guidance for these stakeholders on how to increase and ensure the quality of research processes and results. Moreover, they should improve the reflexive communication among them regarding the means and goals of research.

3 Empirical Basis for the Development of the Requirements Profiles

The requirements profiles were developed based on in-depth analyses of completed research projects addressing topics in the areas "Sustainable City" and "Risk and Precaution in New Technologies." Within these two empirical case studies, which were conducted independently, six (for the former) and five (for the latter) projects were analyzed. The projects chosen for consideration were characterized by the fact that they had either a direct relevance for policymaking or involved policymakers in the research process.

The question that guided the analysis of the projects was what characterizes optimal research constellations that are capable of successful knowledge transfer, and where barriers to such transfers are most likely to arise. The results of these studies, along with examples of how the experience gained from the individual projects was used to develop the requirements profiles, are presented in the final report of the research project underlying this guide (see page 34).[6]

6 "Auf dem Weg zu einer politik-relevanten Nachhaltigkeitsforschung" – download at www.uba.de/uba-info-medien (report in German with English summary).

The requirements profiles developed in this manner were critically discussed at an expert meeting and in discussions with representatives of research funding agencies and contracting entities, researchers and policymakers regarding their practical applicability. The results of these discussions were incorporated into this guide (see page 34).

In addition, existing studies on quality criteria for cross-disciplinary research were evaluated for the development of the requirements profiles. An overview of these studies can be found in the section "Selected Bibliography" (see page 33).

4 Tips on Using the Requirements Profiles

Target Groups of the Requirements Profiles

The requirements profiles for a policy relevant sustainability research presented in the following section are realized as individual catalogs with specific requirements for research funding agencies/contracting entities, researchers and policymakers. The requirements are aimed at both public and private research funding agencies/ contracting entities (for example, state or federal government departments or foundations and associations).

Basically, two constellations of actors can be distinguished here. In one constellation funding agencies/contracting entities and policymakers are different institutions. This constellation mainly represents the model of research funding by actors who have no direct policy consulting needs of their own (for example, funding programs by research ministries, offices or councils on issues of sustainable development). In the other constellation research funding agencies/contracting entities and policymakers are identical (such as a government department that contracts for strategic advice to be used for its own policymaking).

The finished requirements profiles do not distinguish between these two constellations of actors. Instead, for the second constellation, the different requirements catalogs are applied independently of one another to the same actor.[7]

Structure of the Requirements Profiles

The requirements for the three groups of stakeholders were formulated independently of one another, which means, for example, that researchers can apply them even if research funding agencies/contracting entities do not. Ideally, all three groups of actors would apply the appropriate requirements.

The requirements catalogs are structured according to the nine requirement dimensions. In each dimension three temporal phases can be distinguished (for example application, execution and evaluation of a research project). That way, the importance of processes aimed at ensuring and improving research quality is underlined. Specific requirements are formulated for each of these three temporal phases. However, not every dimension is applied in all three phases. So, for example, the dimensions "systemic," "scale spanning" and "prospective" are particularly relevant to the phases of the preparation of a funding measure or the application for a research project.

It should be noted that a requirement that refers to the realization of a quality assurance measure in a subsequent phase is not repeated in that phase. If, for example, an applicant presents a procedure for assessing the impact of a proposed policy, then the subsequent implementation of the procedure will not be formulated as a requirement but simply assumed.

7 The requirements are not tailored to the special case of dedicated departmental research but can be applied usefully to such cases.

Range of the Requirements Profiles

The requirements for research funding agencies/contracting entities come into effect with the formulation of the research program or the call for proposals. The process of identifying topics – research's "agenda setting" – and of coordinating action with other funding agencies and policymakers is not directly addressed by the requirements. As our own empirical studies have shown, however, they can be used for these processes as well to support the actors involved.

The requirements profiles also do not cover the assessment of grant applications or proposals. However, individual requirements can be readily translated into evaluation criteria and it is thus recommended to use them in evaluation procedures. Given the diversity of such evaluation procedures – for example, peer-review, internal evaluation or evaluation by project management agencies – formulating appropriate requirements did not seem expedient.

Application of the Requirements Profile

The extent to which the requirements profiles will be applied during the initiation, execution and implementation of research must be decided on a case-by-case basis. In this sense, the catalogs presented in the following pages form a stock of resources from which the actors addressed can draw depending on their needs. Basically, the requirements profiles are designed so that all requirements can be usefully applied in research project contexts meeting the characteristics as defined in the section "Tips on Using this Guide".[8]

8 Some of the requirements can be applied not only to sustainability research but to research in general. The guide is, therefore, understood as a basis for more broadly defined requirements profiles.

The application of the requirements profiles is meant to ease the burden of the actors involved by providing a common basis for communication regarding the nature of effective quality assurance measures. In line with this, the profiles can be used both in the planning and operational control of processes, as well as in the creation of products. As far as processes are concerned, the requirements profiles can be applied not only during the designated temporal phases but also during the preparation of the evaluation of entire research programs. In addition to its use in preparing calls for proposals, performance descriptions, grant applications and reports of results, the profiles can also be used to create and evaluate utilization plans.

5 Examples of the Application of the Requirements Profiles

In the following, examples are given for all three groups of actors showing how they can use their requirements profiles. The examples shown here are meant only as possible approaches to the profiles. Although the examples were chosen so that they address aspects of general importance for policy-relevant sustainability research, other approaches may be more appropriate in specific cases.

Example of Application for Research Funding Agencies/Contracting Entities

Policy-relevant sustainability research demands integration. The problems that such research deals with require an approach that spans not only disciplinary boundaries but also bridges the gap between science and policy making. Such research must not only combine heterogeneous knowledge bases to form viable opportunities for action. It must also address various institutional and individual actors as knowledge bearers and enable a productive communication among them.

Successful communication, however, requires not only actors with appropriate skills but also a suitable framework. This framework is determined primarily by the structure of the science system and is therefore not directly influenceable by the action perspective adopted in this guide. However, research funding agencies/contracting entities have steering options in project-based research which can be used to effectively support successful integration as a core quality element of policy-relevant sustainability research.

The goal of formulating a funding measure or a contract that creates optimal conditions for successful integration yet provides a practical approach to the requirements profile for research funding agencies/contracting entities: The profile can be examined to check which individual requirements are particularly relevant for integration. Once these requirements are found and prioritized, the question can be posed: "What do we need to do as a research funding agency/contracting entity to adequately implement this specific requirement?"[9]

9 The selection of requirements in the following examples should not be considered mandatory. A different choice may be more appropriate in a given case. The requirements selected were taken from the respective catalog found in section 6.

Approach to the requirements profile of research funding agencies/contracting entities focusing on "Successful Integration"	
Requirement	**Implementation (examples)**
Is the applicant/contractor required to include policymakers and are pointers given indicating the expected form of inclusion?	– make own assessment of which policymakers are relevant in the context of the funding measure/contract and inform these as soon as possible about the upcoming funding measure/contract – clarify, by means of evaluating previous funding activities or by means of involvement of external experts, how and to what extent policymakers should be included given the topic and the goal of the funding measure/contract – if this is not possible in the preparation phase, provide dedicated workshops for users and applicants after publication of the funding measure/contract – clarify to what extent it is possible to support policymakers in their participation in the research process with financial or human resources (specially funded, if necessary)

Are the applicants/contractors asked to select an integrative research approach (e.g., inter-disciplinary or transdisciplinary) and to apply specific quality criteria (if available) for the approach chosen or to name their own?	– while developing the topic and the goals of the funding measure/contract with internal or external experts estimate which disciplines or academic departments must be involved and how heterogeneous the relevant pool of knowledge is – make own assessment of which research approach is most appropriate given the funding measure/contract (using the relevant scientific literature to define this approach as precisely as possible) – investigate to what extent quality criteria are available which apply to the research approach and identify among these which are particularly relevant for successfully implementing the project
Are funding possibilities for integration efforts considered and are applicants/contractors required to submit an elaborated integration concept?	– make own assessment of which integration costs are associated with the funding measure/contract (based on the assessment of which research approach is probably most suitable) – assess, by means of an evaluation of previous funding activities or by means of the involvement of external experts, which percentage of the funding/remuneration should be allocated for integration efforts – ask applicant/contractor to submit an integration concept that takes into account, factually and in resource planning, the own appraisals assembled and, if necessary, justifies deviations – point out to the applicant/contractor that progress in implementation of the integration concept is a part of the reporting requirements
Is a two-stage application procedure considered which supports the development of a common problem description – in particular one negotiated between applicants/contractors and policymakers – and are adequate resources made available for this?	– at an early date of preparing the funding measure/contract check if scheduling allows for a two-stage phase application procedure (to this end, estimate, using the assessments of the first three requirements, how much time is needed ideally for a second stage) – clarify whether in the budget planning resources for financing a second stage – i.e. the preparation of a full proposal/contract – can be provided (if individual resources for potential applicants/contractors are not an option then allocate funds for workshops, networking events or similar activities if possible) – during the design of the two-stage procedure make sure that it supports the development of a common problem description accepted by both researchers and policymakers (e.g., plan for resources for workshops)

The four requirements selected for the example all stem from the preparatory phase of a funding measure/contract. The options available to research funding agencies/contractors for steering a project toward successful integration do not, of course, end with this phase. The researchers can, for example, be supported during the monitoring phase in efforts to link the project with thematically similar other projects. Similarly, the evaluation of a completed funding measure/contract with respect to integration can help to optimize future activities.

Some of the requirements selected for the example may call for additional resources not available to every funding measure/contract. Facing such limits, it may be useful to focus on those requirements that enable reaching the clearest agreement on the outcome to be produced and this way supporting integration.

Example of Application for Researchers

In the academic discourse on cross-disciplinary research it is repeatedly stressed that a common problem description accepted by – as in the case considered here – both scientists and policymakers is crucial. Research results with usability can in most cases only be achieved if the practical problem is described as exactly as possible and translated into a scientific question. Here, the crucial assumption is that problems arising within the context of sustainable development are as a rule, due to their complexity, not clearly determinable.

If this process of joint problem description remains implicit, or is omitted entirely, then different expectations by policymakers and researchers of what can or is to be achieved with the research may arise. A high potential for conflict may then develop which may break out during the research process and in many cases may no longer be resolvable. For researchers, therefore, it is of utmost importance that this question be dealt with already when applying for a research project.

This focus on a common problem description provides yet another way of accessing the requirements profile for researchers: it can be examined with respect to which requirements relate precisely to this point. Once such requirements are identified, they can be – in a manner similar to the example for research funding agencies/contracting entities – prioritized. Then the question may be asked: "What do we need to do as researchers to implement this specific requirement adequately?"

Approach to the requirements profile of researchers focussing on: "Common Problem Description"	
Requirement	**Implementation (examples)**
Is the particular problem to be studied agreed upon with the policymakers (and possibly with the research funding agency/contracting entity as well) or does the project's implementation concept include a procedure for reaching such an agreement?	– make contact with potential policy making practice partners as early as possible before application and hold a workshop on "Common Problem Description" (include research funding agencies/contracting entities) – if there are no resources for a workshop, design the implementation plan in such a way that a common problem description can be achieved during the research process – agree on the relevant points of the implementation plan with the policymakers before the application – work with proven concepts and methods for determining a common problem description
Is the policy problem translated into a scientific research question?	– review the relevant state of knowledge and relate it to the common problem description – identify gaps in the current state of knowledge and (with the help of models, hypotheses, theories, etc.) translate these into questions to be worked on with scientific methods – include here, as far as possible, the entire research team and identify possible sub-questions for individual disciplines – inform the policymakers before the application (ideally in a second workshop) of the scientific questions identified or provide for such an information transfer in the project implementation plan

Have the project's scientific and practical knowledge goals been differentiated and has a corresponding weighting been carried out and justified?	− before the application invite the policymakers to disclose their own goals for the project in the context of the problem description identified − determine what potential lies in the scientific questions identified and develop this into appropriate scientific project goals (e.g., peer reviewed publications, presentations at conferences, theses, follow-up projects, etc.) − determine the extent to which the project has rather more practical than scientific relevance and provide this assessment to all participants
Is the expected contribution of the project to resolving the policymaking problem assessed?	− clarify with the policymakers what degree of achievement of their project goals will count as success − assess how realistic the expectations of the policymakers are and, if necessary, adjust these together with them
Is a procedure provided for, in cooperation with the policymaking partner (and, if necessary, with the research funding agency/contracting entity), which permits, in the course of the project, a revision of the problem description in the light of new knowledge?	− set revision points in the implementation plan at which the current state of knowledge can be applied to the scientific questions identified − provide for a procedure that allows for any necessary modifications of the scientific questions identified and thus of the common problem description (provide for participation of the policymakers!)

In this example, five individual requirements were identified which are of special importance during the application phase for the successful determination of a common problem description. Although the application phase was singled out here, it is clear that in implementing the individual requirements, communication with the policymakers concerning the project's problem description is also very important during the implementation and evaluation phases of a research project

If the problem has already been precisely defined − as in the case of commissioned research − access to the requirements profile can be gained by dealing with the task of developing a suitable, methodically specific implementation or integration plan. Here, the pertinent question may be what is the real scientific interest in implementing the project.

Example of Application for Policymakers

For policymakers participating in a project the quality of the research results is essential. These results must take into account the policy making context specific to the problem worked on so that the results are readily usable. To make such results possible it is crucial that appropriate knowledge of the context is channeled into the research process. If such a knowledge transfer is not explicitly perceived by the policymakers as one of theirs tasks, or is perceived as such too late, there is a risk that the policymakers' consulting needs will not be met by the research.

The need for such a knowledge transfer, however, provides policymakers with a possible approach to their requirements profile. They can pay particular attention to those requirements that address the knowledge transfer to researchers. If the corresponding requirements are highlighted and prioritized, they can be addressed – again, analogous to the examples for the research funding agencies/contracting entities and researchers – by asking: "What do we need to do as policymakers to implement this specific requirement adequately?"

In the example both requirements that relate to participation in applying for a research project and those that relate to participation in such a project's implementation were selected. Often, however, it is difficult for local policymakers to come up with the necessary time or human and financial resources. This also became clear in the expert meeting carried out in the course of the research project underlying this guide (see page 11). As an alternative approach to the requirements profiles, policymakers can then focus on requirements aimed at determining whether a continuous involvement in the research process is possible.

Approach to the requirements profile for policymakers focusing on: "Knowledge Transfer"	
Requirement	**Implementation (examples)**
Is there active participation in the formulation of a common description of the problem?	– clarify what time and human resources are available for participating in applying for a research project (share this information immediately with the research partners) – provide own problem description and formulate specific expectations for possible project results (for this hold an internal workshop if possible) – investigate the extent to which internal flexibility allows for revision of the problem description in the course of the project if new knowledge calls for this (with expectations for research results modified accordingly) – take up the researchers' offers (and those of research funding agencies/contracting entities) to participate in workshops or similar events aimed at developing a common problem description and actively contribute one's own assessments and positions there

Are the conditions for actually implementing the expected policy recommendations identified and communicated early enough to the researchers?	– clarify on the basis of the common problem description what the critical conditions are on which the implementation of research results depend, which positions are affected by implementation and to what extent a time factor, e.g. a "window of opportunity," has to be taken into account (to this end hold an internal workshop) – record the results of this clarification in a position paper that is provided to the researchers at the earliest point possible while applying for the project and which also allows conclusions to be drawn about one's own criteria of success for participation in the project – invite research partners to comment on this paper and – possibly in revised form – to use it during project planning
Are changes in one's own policy, institutional or temporal framework, as well as in one's own goals communicated at an early stage in the course of executing the project?	– Submit a workflow analysis in which the position paper described above is regularly checked and, if necessary, modified or further developed (taking into account any new knowledge produced during the research process) – establish a procedure that promptly informs researchers about such developments (check here to see if researchers can participate in relevant internal meetings) – regularly check whether other policymakers must be involved in order to be able to work out robust policy recommendations, and pass on such assessments to the researchers – periodically review the conditions needed for a continuous participation in the research process and, if necessary, agree on changes with the researchers or the research funding agencies/contracting entities

6 Requirements Profiles for a Policy Relevant Sustainability Research

The requirements profiles for a policy relevant sustainability research will be introduced in two steps. First, core requirements are discussed. Then, in a second step the comprehensive requirements catalogs are presented. The core requirements and the requirements catalogs are presented separately for research funding agencies/contracting entities, researchers and policymakers.

Core Requirements

Identifying nine core requirements for each of the three groups of stakeholders has two functions. The catalogs include a wide spectrum of requirements. Not all of these requirements are of equal importance for every possible case. The core requirements are thus designed, on the one hand, to enable wide applicability of the guide and to facilitate access to the comprehensive requirements catalogs. And, on the other hand, they should offer actors guidance also for those research projects that do not meet the characteristics described in section "Tips on Using this Guide".

Core requirements for research funding agencies/contracting entities

Is the possibility of funding implementation projects following the current funding measure earmarked and are performance criteria for the granting of such projects defined?

→ *requirement dimension "impact oriented"*

Is the applicant/contractor asked to justify which dimension or systemic aspect of the policy-making action field is not examined (in terms of dealing with complexity)?

→ *requirement dimension "systemic"*

Are the essential levels of action and actors in the policymaking action field named in the research program or call for proposals?

→ *requirement dimension "scale spanning"*

Does the research program or call for proposals provide for measures to promote a "learning research process" (for example, information events during the application phase, goal setting activities, review points, cross-cutting activities, monitoring research)?[10]

→ *requirement dimension "critical-reflexive"*

Are funding possibilities for integration efforts considered and are applicants/contractors required to submit an elaborated integration concept?[11]

→ *requirement dimension "integrative"*

Is a two-stage application procedure considered which supports the development of a common problem description, in particular one negotiated between applicants/contractors and policy-makers, and are adequate resources made available for this?

→ *requirement dimension "integrative"*

Is the applicant/contractor required to provide an estimate of the potential benefit of the research to policymaking and to science?

→ *requirement dimension "impact oriented"*

Is the possibility of revising the goals of a funding measure in light of new scientific knowledge considered in the monitoring of the measure?

→ *requirement dimension "critical-reflexive"*

Is the funding measure evaluated upon completion with regard to the possible improvement of future funding measures?

→ *requirement dimension "critical-reflexive"*

10 Interdisciplinary and transdisciplinary cooperation demand a high willingness to learn on the part of all parties. Everyone must be open to new forms of knowledge, new communication cultures and different institutional interests. In a "learning research process" willingness to learn is not assumed; rather, such a learning research process is facilitated with appropriate measures.

11 An integration concept indicates which methods can best facilitate scientific cooperation among participating academic departments and scientific disciplines. It also shows how cooperation with non-scientific stakeholders, as well as a dialogue with society, should be organized.

Core requirements for researchers

During the making of the proposal are appropriate policymaking partners identified and is it clear whether there are incentives for their participation and whether the institutional and financial conditions enabling their active and continuous participation in the research process are given?

→ *requirement dimension "context specific"*

Is the concrete problem to be studied agreed upon with the policymakers (and possibly with the research funding agency/contracting entity as well) or does the project's implementation concept include a procedure for reaching such an agreement?

→ *requirement dimension "context specific"*

Does the proposal explain which dimensions or systemic relationships within the context of a policymaking action field will not be studied and how this reduction of complexity should be dealt with in the course of the project?

→ *requirement dimension "systemic"*

Does the proposal include an elaborated integration concept with defined integration goals, and are the costs of the integration efforts adequately accounted for in the resource planning?

→ *requirement dimension "integrative"*

Does the project's execution concept provide for measures that enable a learning research process or are the appropriate offers or guidelines provided by the research funding agency/contracting entity taken into account?

→ *requirement dimension "critical-reflexive"*

Is a strategy for the transfer of knowledge developed and presented in the proposal and is there an outline showing how it should be implemented?

→ *requirement dimension "impact oriented"*

Does the project provide for a continuous transfer of knowledge among the participating disciplines and between the project team and the participating policymakers?

→ *requirement dimension "integrative"*

Are the project's outcomes temporarily and linguistically compatible with the needs and expectations of the policymakers and is this regularly checked during the course of the project?

→ *requirement dimension "impact oriented"*

Does the final report clearly present the potentials and limits of the practical and scientific knowledge gained in the project?

→ *requirement dimension "critical-reflexive"*

Core requirements for policymakers
Are own financial and human resources committed to ensuring ongoing involvement in the research project or is the need for appropriate additional resources indicated (to the funding agencies or researchers)? → *requirement dimension "integrative"*
Is the timely application for an implementation project considered or is an internal process launched to implement the results of the research? → *requirement dimension "impact oriented"*
Are the conditions for actually implementing the expected policy recommendations identified and communicated to the researchers early enough? → *requirement dimension "context specific"*
Are distinct success criteria for the project defined in consultation with the researchers? → *requirement dimension "impact oriented"*
Are the own targets for the principly open-ended research process set broadly enough and can unexpected research results be communicated internally? → *requirement dimension "prospective"*
Is it regularly checked during the course of the project, whether there are options for implementing the policy recommendations developed? → *requirement dimension "impact oriented"*
Are changes in one's own policy, institutional or temporal framework, as well as in one's own goals communicated at an early stage in the course of executing the project? → *requirement dimension "context specific"*
Are the researchers promptly informed about potential synergy effects or conflicts with the policymaker's own new policy objectives or those of others? → *requirement dimension "scale spanning"*
Is the knowledge generated adequately safeguarded and made available for the own policymaking practice (possibly in consultation or cooperation with the researchers)? → *requirement dimension "impact oriented"*

Requirements Catalogs

In the following section the comprehensive requirements catalogs for research funding agencies/contracting entities, researchers and policymakers are presented. The structure of the catalogs corresponds to the nine requirement dimensions of sustainability research (see Table page 8). Within each dimension, three time phases are distinguished (see Section 4) and, where applicable, appropriate requirements assigned. The core requirements introduced above are indicated in the three catalogs below.

For research funding agencies/contracting entities and researchers the focus of the requirements is on the first phase (either preparing a funding measure/contract or a proposal for a research project). There are two reasons for this. On the one hand, this phase is particularly important: errors made while formulating a call for proposals or during the application process are difficult to correct at a later point – here a path gone down can only be abandoned with great difficulty. On the other hand, the following phases are to a greater extent more case-specific, that is more dependent on the particular subject matter and goal of a given research process. In contrast to these two stakeholders, the requirements for policymakers are distributed more evenly across all three phases.

Research funding agencies/contracting entities		
systemic	**scale spanning**	**prospective**
I Preparing a funding measure/contract		
Are the environmental, social and economic aspects of the policy action field considered? Is the applicant/contractor asked to justify which dimension or systemic aspect of the policy-making action field is not examined (in terms of dealing with complexity)? → *core requirement*	Are the essential levels of action and actors in the policymaking action field named in the research program or call for proposals? (e.g., municipal, regional, national or international/global)? → *core requirement*	Do the own goals support an open-ended research process? Are potential conflicts or synergies arising between one's own actions and those of others on the policymaking action field in question indicated?
II Monitoring a funding measure/contract		
		Are recent policy developments relevant to the policymaking action field in question identified and communicated to the researchers?
context specific	**integrative**	**method based**
I Preparing a funding measure/contract		
Are the societal and policymaking actors relevant to the policymaking action field in question identified? Are the knowledge or consulting requirements specific to the policymaking action field in question clearly formulated? Is there an estimate of the temporal development of the policymaking action field and is it matched to the duration of the funding measure/contract and to the foreseeable amount of research work to be carried out? Is the applicant/contractor asked to focus on the problem from a scientific perspective or to adapt to the consulting needs of the policymakers to be included?	Is the applicant/contractor required to include policymakers and are pointers given indicating the expected form of inclusion? Are funding possibilities for integration efforts considered and are applicants/contractors required to submit an elaborated integration concept? → *core requirement* Is a two-stage application procedure considered which supports the development of a common problem description – in particular one negotiated between applicants/contractors and policymakers – and are adequate resources made available for this? → *core requirement*	Are the applicants/contractors required to provide an overview of the relevant state of knowledge and the methods to be used? Is the possibility of developing a cross-disciplinary, problem specific research approach provided for? Are the applicants/contractors asked to select an integrative research approach (e.g., interdisciplinary or transdisciplinary) and to apply specific quality criteria (if available) for the approach chosen or to name their own?

II Monitoring a funding measure/contract		
Are changes in policymaking priorities and in the temporal development of the policymaking action field promptly communicated?	Are opportunities for networking with other projects covered by the funding measure/contract or with relevant policymakers supported?	
critical-reflexive	**normative**	**impact oriented**
I Preparing a funding measure/contract		
Does the research program or call for proposals provide for measures to promote a "learning research process" (for example, information events during the application phase, goal setting activities, review points, cross-cutting activities, monitoring research)? → *core requirement* Is the applicant/contractor required to make an initial assessment of the consequences of implementing the policy recommendations developed? Is the applicant/contractor required to determine the various roles researchers and policymakers will play during the project and to consider the potential for conflict among these roles?	Is one's own understanding of sustainability made explicit and applied to the policy making action field in question, and is reference made, where appropriate, to existing sustainability goals (e.g, in the context of a national sustainability strategy)? Is the applicant/contractor required to refer to an existing understanding of sustainability and to justify possible deviations from this? Is an own estimate made of which kind of sustainability knowledge (system, orientation or transformation knowledge) should be produced by the funding measure/contract?	Are the own expectations concerning the form and usefulness of the research results formulated and communicated? Is the applicant/contractor required to provide an estimate of the potential benefit of the research to policymaking and to science? → *core requirement* Are the applicants/contractors required to provide a knowledge transfer strategy? Is the possibility of funding implementation projects following the current funding measure earmarked and are performance criteria for the granting of such projects defined? → *core requirement* Are the policymakers required to declare their readiness in principle to implement the project results?
II Monitoring a funding measure/contract		
Are the measures funded to support a learning research process implemented? Is the possibility of revising the goals of a funding measure in light of new scientific knowledge considered in the monitoring of the measure? → *core requirement*		Are the policymaking partners supported (logistically, financially) during preparation of an implementation project? Are the specified success criteria for deciding on the financing of an implementation project vetted?

III Evaluating a funding measure/contract		
Are the researchers required to describe the limits of the research results or policy recommendations developed? Is the funding measure evaluated upon completion with regard to the possible improvement of future funding measures? → *core requirement*		Are the researchers required to describe the contribution of the research to achieving the goals set by the funding program? Are the policymakers supported in the realization of an implementation phase (logistically, symbolically)? Are the researchers required to safeguard the new knowledge produced during the project and make it accessible?

Researchers

systemic	scale spanning	prospective
I Applying for a research project		
Is it shown which theoretical understanding of "system" (i.e., a concept of the interaction between society and environment) is in play and how systemic relations within the context of the policymaking action field are to be investigated? Does the proposal explain which dimensions or systemic relationships within the context of a policymaking action field will not be studied and how this complexity reduction should be dealt with in the course of the project? → *core requirement*	Are adjacent policymaking action fields identified and is it shown how potential synergies or conflicts should be included and studied?	Is an explicit procedure established that helps to ensure the open-endedness of the research project in view of the policymaking goals of the funding measure/ contract or of the policymakers? Is an approach developed with which to study the consequences of implementing the policy recommendations?
II Executing a research project		
	Is the extent studied to which the policy recommendations developed are compatible with relevant developments in other actions fields?	

context specific	integrative	method-based
I Applying for a research project		
During the making of the proposal are appropriate policymaking partners identified and is it clear whether there are incentives for their participation and whether the institutional and financial conditions enabling their active and continuous participation in the research process are given? → *core requirement* Is the concrete problem to be studied agreed upon with the policymakers (and possibly with the research funding agency/ contracting entity as well) or does the project's implementation concept include a procedure for reaching such an agreement? → *core requirement*	Are reasons provided justifying the composition of the project team regarding the scientific and technical expertise needed to work on the policymaking problem in question? Does the proposal include an elaborated integration concept with defined integration goals, and are the costs of the integration efforts adequately accounted for in the resource planning? → *core requirement*	Is an integrative research approach (e.g., interdisciplinary or transdisciplinary) selected and is it vetted for its suitability for dealing with the problem as described? Is the relevant existing pool of knowledge surveyed and are already existing methods for dealing with the problem as described identified? Is it shown to what extent it might be necessary to develop new problem specific methods for dealing with the problem as described?

critical-reflective	normative	impact oriented
Is the policy problem translated into a scientific research question? Are the social groups relevant to the policymaking action field identified and is it shown how their knowledge, as well as possible value and interest conflicts among them, are to be taken into account? Is the research concept aligned with the time line of the policy action plan such that, for example, short-term, medium-term and long-term goals have been distinguished?	Is it shown how the participating disciplines will work together to produce the knowledge needed and how they will work together with the policymaking partners? For two stage application processes: Is it explained in applying for the first stage how the policymaking partner should be involved in the research process and how a common problem description will be developed by the start of the second phase?	Is an orientation towards additional quality criteria, where present, referred to, or do the researchers establish their own quality criteria?

II Executing a research project		
Are the conditions for implementing the policy recommendations developed examined and are adjustments, if necessary, made to the product design?	Is cooperation within the project team and the involvement of the policymaking partner regularly reflected on and are adjustments made, when necessary, to the integration concept? Does the project provide for a continuous transfer of knowledge among the participating disciplines and between the project team and the policymakers? *→ core requirement* Are offers to exchange experiences with other projects under the same funding measure or with relevant policymakers taken advantage of?	Is an evaluation made of the knowledge produced following recognized methods or are ones specifically developed for the problem under study? Is an explicit translation made of the scientific results produced into practical solutions to problems? Is compliance with any additional quality criteria that may have been applied checked regularly?

critical-reflective	normative	impact oriented
I Applying for a research project		
Does the project's execution concept provide for measures that enable a learning research process or are the appropriate offers or guidelines provided by the research funding agencies/ contracting entities taken into account? *→ core requirement*	Has one's own understanding of sustainability been clearly presented and related to the policymaking problem in question? Have differences, where present, vis-à-vis the understanding of the research funding agency/contracting entitiy been justified?	Is a strategy for the transfer of knowledge developed and presented in the proposal and is there an outline showing how it should be implemented? *→ core requirement* Have the project's scientific and practical knowledge goals been differentiated and has a corresponding weighting been carried out and justified?

Is a procedure provided for, in cooperation with the policymaking partner (and, if necessary, with the research funding agency/contracting entity), which permits, in the course of the project, a revision of the problem description in the light of new knowledge? Is the researchers' own role and that of the policymaking partner explicitly made conscious and presented clearly in the proposal?	Is it shown which kind of sustainability knowledge will be produced (systems, transformation or orientation knowledge) and are reasons given to justify any deviations from the research funding agency's/contracting entity's, or the policymaking partner's, assessment?	Is the expected contribution of the project to resolving the policymaking problem assessed? Do the researchers set (as far as possible in concert with the policymaking partners) their own success criteria for the project or are already existing success criteria used? Does the research design include resources that can be used to deal on short notice with incidental policy consulting needs?
II Executing a research project		
Are measures supporting a learning research process carried out and checked as to their effectiveness? Are the disciplinary or departmental premises, hypotheses, paradigms, etc. systematically disclosed?		Are the project's outcomes temporarily and linguistically compatible with the needs and expectations of the policymakers and is this regularly checked during the course of the project? → *core requirement*
III Evaluating a research project		
Does the final report clearly present the potentials and limits of the practical and scientific knowledge gained in the project? → *core requirement* Is the entire project evaluated in terms of the success or failure of the integration goals?		Is an assessment made of whether the practical knowledge goals are achieved and to what extent the results can be transferred to other policymaking actors or action fields? Is an assessment made of whether the scientific knowledge goals are achieved and generalized beyond the context of the problem studied? Is the system knowledge, transformation knowledge or orientation knowledge produced in the project worked up and saved in appropriate media and formats?

Requirements profile for policy relevant sustainabilty research

Policymakers

systemic	scale spanning	prospective
I Participating in the application for a research project		
	Are current policy projects (possibly at different policy levels or within different action fields) which stand in relation to the proposed project being communicated?	Are the own targets for the principly open-ended research process set broadly enough and can unexpected research results be communicated internally? → *core requirement*
II Participating in the execution of a research project		
	Are the researchers promptly informed about potential synergy effects or conflicts with the policymaker's own new policy objectives or those of others? → *core requirement*	

context specific	integrative	method-based
I Participating in the application for a research project		
Are the conditions for actually implementing the expected policy recommendations identified and communicated to the researchers early enough? → *core requirement* Are the own policy goals explicitly communicated to the researchers?	Are own financial and human resources committed to ensuring ongoing involvement in the research project or is the need for appropriate additional resources indicated (to the funding agencies or researchers)? → *core requirement* Is there active participation in the formulation of a common description of the problem?	Is the researchers' method-based procedure for producing, integrating and evaluating knowledge accepted?
II Participating in the execution of a research project		
Are changes in one's own policy, institutional or temporal framework, as well as in one's own goals communicated at an early stage in the course of executing the project? → *core requirement*	Is there active participation in the research process and are offers of such participation acknowledged by the researchers?	

critical-reflective	normative	impact oriented
I Participating in the application for a research project		
Is the own role reflected in the research project and, where necessary, explained to the researchers? Is the extent to which the project is compatible with the own structures and processes taken into account?	Is the own understanding of sustainability clearly communicated or is reference explicitly made to the sustainability understanding of the research funding agency/contracting entity or researchers? Are the own concrete sustainability goals, if any, communicated to policymaking action field? Is an assessment made of which kind of sustainability knowledge (system, transformation or orientation knowledge) is needed for the own policymaking?	Can a basic willingness to implement the expected project results be confirmed? Are distinct success criteria for the project defined in consultation with the researchers? → *core requirement* Are the own expectations regarding the form and usefulness of the project results communicated to the researchers?
II Participating in the execution of a research project		
Are uncertainty, fluctuations and alternative solutions understood as part of the research process? Is there a willingness to revise the original project goals in light of new knowledge produced during the research process?		Is it regularly checked during the course of the project, whether there are options developed for implementing the policy recommendations? → *core requirement* Is the timely application for an implementation project considered or is an internal process to implement the results of the research launched? → *core requirement*
III Utilizing a research project		
Are the costs of participating in the research process in relation to the impact on policymaking evaluated and are the results communicated to the research funding agency/contracting entity?	Are the own sustainability goals or sustainability understanding reviewed in light of the project results and, if needed, revised?	Is an assessment made as to whether the project results have had an impact on policymaking and is the outcome communicated to the researchers and the research funding agency/contracting entity? Is the knowledge generated adequately safeguarded and made available for the own policymaking practice (possibly in consultation or cooperation with the researchers)? → *core requirement*

7 Selected Literature

In addition to the empirical analysis of selected case studies drawn from the research areas "Sustainable City" and "Risk and Precaution in the case of New Technologies" (see page 11) the following studies on quality criteria for cross-disciplinary research were evaluated:

Bergmann, M., 2006. Transdisziplinäre Forschung erfolgreich fördern. Institut für sozial-ökologische Forschung (ISOE), Berlin, Juni 2006.

Bergmann, M., Brohmann, B., Hofmann, E., et al., 2006. Quality Criteria of Transdisciplinary Research: A Guide for the Formative Evaluation of Research Projects. ISOE-Studientexte, No 13, Frankfurt am Main.

Böcher, M., Krott, M., 2010. Umsetzung des Konzepts einer modernen Ressortforschung im Geschäftsbereich des BMU. Umweltbundesamt Dessau-Roßlau, UBA-Texte, 39/2010.

Maasen, S., 2005. Interdisziplinarität und ihre Förderung – Interdisziplinäre Projekte im Nationalfonds, Expertise im Auftrag des Schweizerischen Nationalfonds.

Wissenschaftsrat, 2008. Pilotstudie Forschungsrating Soziologie. Abschlussbericht der Bewertungsgruppe, Köln.

Ziegler, R., Ott, K., 2011. The Quality of Sustainability Science – a philosophical perspective. Sustainability: Science, Practice & Policy, 7/1, 31–44.

The formulation of the working definition of "sustainability research", as well as the derivation of the nine requirements dimensions (see table page 8), is based on a review of the relevant scientific literature appearing during the last 12 years. The following list shows selected seminal articles:

Bettencourt, L.M.A., Kaur, J., 2011. Evolution and structure of sustainability science. PNAS, 108/49, 19540–19545.

Clark, W.C., Dickson, N.M., 2003. Sustainability science: The emerging research program. PNAS, 100/14, 8059–8061.

Jahn, Th., 2012. Theorie(n) der Nachhaltigkeit? Überlegungen zum Grundverständnis einer „Nachhaltigkeitswissenschaft. In: Enders, J.C., Remig, M. (Hg.). Perspektiven nachhaltiger Entwicklung. Theorien am Scheideweg. Marburg: Metropolis Verlag, 47–64.

Jerneck, A., Olsson, L., Ness, B., et al., 2011. Structuring sustainability science. Sustainability Science, 6, 69–82.

Kates, R.W., Clark, W.C., Corell, R., et al., 2001. Environment and Development – Sustainability Science. Science, 292, 641–642.

Lubchenko, J., 1997. Entering the Century of the Environment: A New Social Contract for Science. Science, 279, 491–497.

Reid, W.V., Chen, D., Goldfarb, L., Hackmann, H., et al., 2010. Earth System Science for Global Sustainability: Grand Challenges. Science, 330, 916–917.

Swart, R., Raskin, P., Robinson, J., 2002. Critical Challenges for Sustainability Science. Science, 297, 1994.

Information about the Project

The results presented here are part of a research and development project (Research Code Number: 3711 11 701) funded by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) and the German Federal Environment Agency (UBA). The project was carried out by the Institute for Social-Ecological Research (ISOE, project management), the Institute for Ecological Economy Research and the Environmental Policy Research Center for of the Freie Universität Berlin (FFU) (project duration: 09/2011-01/2013).

The aim of the project was to develop concepts that can be used to increase the relevance of sustainability research for the design of environmental policy in Germany. In addition to the requirements profiles for a policy relevant sustainability research presented in this guide, recommendations, based on empirical studies, have been developed regarding how the coordination between different government departments with respect to funding such research can be optimized. The project's final report is available on UBA's website.[12]

Acknowledgments

A dialogue forum, "Quality and Relevance of Sustainability Research", was set up as part of the project. In several rounds of talks the results presented in this guide were critically discussed and options for their implementation were explored. A special thanks go to the participants of the dialogue forum:

Dr. Jan Helmke (Institute for Advanced Sustainability Studies, IASS), Dr. Christian Hey (German Advisory Council on the Environment, SRU), Dr. Karl Eugen Huthmacher (Federal Ministry of Education and Research, BMBF), Dr. Jürgen Jakobs (Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, BMU), Dr. Johanna Leissner (Fraunhofer-Gesellschaft, Brussels Office), Heinrich Nöthe (Federal Ministry of Transport, Building and Urban Development, BMVBS), Dr. Inge Paulini (German Advisory Council on Global Change, WBGU), Prof. Dr. Ernst Th. Rietschel (acatech – National Academy of Science and Engineering, past president of the Leibniz Association), Dr. Wolfgang Rohe (Mercator Foundation), Dr. Dagmar Simon (Social Science Research Center Berlin, WZB), Prof. Dr. Werner Wahmhoff (German Federal Foundation for the Environment, DBU).