Strategy's objectives. While the High-tech Strategy does not have specific funds in form of specific funding programmes assigned to its implementation, the impact of the economic innovation discourse is actually much deeper: The entire ministry is organized according to the objectives of the High-tech Strategy on a crosscutting structural level. Most – if not all – existing funding activities are subsumed under the High-tech Strategy's umbrella. Accordingly, the overall BMBF funding is aimed at fulfilling the High-tech Strategy's objectives; this can be traced in the official governmental budgetary planning for the BMBF, which is ordered according to the High-tech Strategy and organizes all different funding activities in its frame (Bundesregierung 2012a). As funding initiatives emerge within the organisational structure of departments and working units of the ministry (ch. 6), the overall BMBF discourse thereby permeates into all thematic as well as crosscutting science policy discourses such as those on cooperation and sustainability.

In addition to the structural impact on the organisation of funding, the discourse underlying the High-tech Strategy possesses ideational authority within the BMBF. The core thinking presets the potential pathways that further policies can potentially follow, thus functioning as a historical a priori which both enables as well as delimits the development of subdiscourses in science policy. This becomes clear in its impact on further funding strategies and their underlying ideas. Although the BMBF's leitmotif is most plainly and transparently exhibited in statements on the general direction of science policy, such as in the High-tech Strategy, it nevertheless pervades all further specialized discourses of science policy, such as those bundled in thematic and crosscutting strategies.

8.2 The green lungs: Sustainability as a new discourse in science policy

The perpetuation of a science policy based on technological and applied research targeting economic wellbeing illustrates the point of self-reinforcing ideas and structures in discourse. In contrast, new concepts may still be taken up. This exemplifies that the interplay between the discourse's idea and the structures that carry it, its dispositive, does not necessarily lead to a lock-in or an unchangeable system. The introduction of sustainability as a novel concept in science policy demonstrates this point. As a discursive frame of policy for cooperation with developing countries and emerging economies, sustainability is gaining increasing importance.

8.2.1 Environmental research as a starting point

The BMBF's conception of sustainability still is strongly based on the environmental dimension, which surged as a new topic in science policy in the 1980s, in close connection to the discursive context of its time. While the predecessors of the BMBF

had started to include environmental research in their portfolios sporadically in the late 1960s, as off the 1970s and 1980s public debates were increasingly coined by environmental consciousness, culminating in public reflections of discourses such as on *Waldsterben*, acid rain, and risks of nuclear power (Weingart 2006). Environmental problems and their reflection in the uprising public environmental discourse led to institutional changes at larger scale within the German government. As such, the Federal Environmental Agency (*Umweltbundesamt*) was founded in 1974. The environment increasingly turned into a political issue, which lead to the creation of the German Green Party in 1980, bundling several grass roots initiatives and alternative political groupings. Finally, as a first ministry for environmental issues, the Federal Ministry of the Environment, Nature Conservation and Nuclear Safety (BMU) came into being in 1986 in order to politically cope with the nuclear disaster which had occurred in Chernobyl, Ukraine, in the same year (Weingart 2006).

Mirroring the public and political discourse, the BMFT, ministry responsible for research at the time, slowly extended its scope of research funding to a broader spectrum of environmental concerns (PA12). While the first research funding initiatives for environmental protection were disconnected and incoherent (Weingart 2006), the support became more strategic when BMFT funding was aligned to a national strategy on environmental research and environmental technology development in 1984 (BMFT 1990).

New global ecological developments found their way into science policy via public discourse. While anthropogenic influence on the earth system had been dealt with scientifically since the 1970s, it only entered the public arena in the early 1980s, with related conceptualisations such as the depletion of the ozone layer, the greenhouse effect, and climate change. Increasingly recognizing the scope and importance of the problem, the Intergovernmental Panel on Climate Change (IPCC) was funded in 1988 (Weingart 2006), while nationally, the BMFT issued a research programme for ozone research in the same year (BMFT 1988). A funding priority on the greenhouse effect followed in 1989 (BMFT 1989). Expenditures on climate related research of the BMFT dramatically increased from 3.6 million Deutsche Mark (equivalent to app. EUR 1.8 million) in 1982 to 220 million Deutsche Mark (equivalent to app. EUR 110 million) in 1991 (Weingart 2006: 277).

Next to climate research, the Programme for Environmental Research and Environmental Technologies 1989-94 (BMFT 1990) sought to foster environmental research on human impacts on the environment, environmental stress, and remediation of environmental damages. This was legitimized by the picturing responsible environmental policy as a part of (infra-)structural policies of the future (BMFT

1990).[2] Starting in the mid-1990s, with the Research Programme for the Environment, the focus began to change from maintenance and remediation research towards preventive environmental research (BMBF and BMU 2008a), a fact that can be linked to the emerging global sustainability discourse.

8.2.2 Sustainability enters science policy

In the 1990s, the concept of sustainable development entered science policy as a novel idea, which interlinked aspects of environmental, social and economic development within a systemic approach (ch. 2). In view of its impact on science, the Agenda 21 following the UNCED conference in Rio in 1992, was especially relevant for a shift towards a concept a preventive science for sustainable development. The Agenda 21 emphasized the "role and the use of the sciences in supporting the prudent management of the environment and development for the daily survival and future development of humanity" (UNCED 1992b 35.1). At the same time, it stressed the importance of scientific inputs as a basis of political decision-making on issues of sustainable development (UNCED 1992b: 31.1).

Next to the surging international discourse on sustainability manifesting itself in the Agenda 21 as well as other international treaties following the Earth Summit, sustainability discourse began to institutionalize itself in strategies on the European and national level. The European Commission issued an influential white paper on Growth, Competitiveness and Employment in 1993, which included a section on a new, sustainable, development model (European Commission 1993). A former BMBF staff pointed at the importance of this paper for science policy: "This gave us a push, because it spelled out what sustainable development meant for science policy, namely the pursuit of an alternative development path. That's what it is about! It started in 1993, and from then on spread out a little bit." (PA12)

The BMBF's forerunner, the BMFT, followed the European Union's footsteps and took up sustainability as a policy concept. As of the early 1990s, the ministry specifically related to sustainability in its research programmes. The Forschungsrahmenkonzeption Globale Umweltveränderungen 1992-1995 (BMFT 1992) referred to sustainable development as defined in the Brundtland report as a guiding concept, stressed the socio-ecological aspects of environmental problems and their global dimensions. In consequence, first interdisciplinary funding priorities like SHIFT ("Studies of Human Impact on Forests and Floodplains in the Tropics") emerged for cooperation with Latin American countries (BMFT 1992).

After the national elections in 1998, change in political leadership from the conservative Christian Democratic Party (CDU) to the Social Democrats (SPD) further

2 The programme was rather focussed on dealing with pollution through technological research, and, as later programmes, asked for a market-based application of the results though SMEs.

strengthened sustainability as a politically relevant discourse across political scales. On the national German level, a governmental commission was set up in order to discuss sustainability and the protection of people and environment, the Enquete-Kommission des Deutschen Bundestages "Schutz des Menschen und der Umwelt" (13. Deutscher Bundestag 1998). In 2001, the European Union issued a sustainability strategy; Germany followed with a national sustainability strategy in 2002, drawing on international treaties following the UNCED Rio process (Bundesregierung 2012b).

With instances of national and international recognition and institutionalisation, the international public and policy discourse on sustainability became powerful enough to motivate even the previously conservative political parties to use the political opportunities and become part of the discourse coalition on sustainability – jumping on the sustainability bandwagon (interview with PA14). In the early 2000s, the minister then in charge of science and education, Edelgard Bulmahn (SPD), established a working group for sustainability research within the ministry. The group started discussions on a research programme for sustainability, which later became FONA (interviews with PA04, PA14). By issuing FONA in 2005, the BMBF turned into a visible speaker within the discourse community on sustainability, while at the same time responding to demands for action arising from both international as well as national conventions and strategies in which the rising discourse of sustainability had cumulated. As such, FONA became part of the national sustainability strategy of the German government, which obliged different governmental departments to contribute (interviews with PA04, PA12, PA14).

SKAD explains the relation between discourse and its dispositive as a mutual influence of ideas and corresponding structures, which are self-reinforcing. The emergence of environmental research as a topic of science policy and the subsequent development of FONA, framed as by sustainability discourse, exemplify how a new (sub)discourse establishes itself and later on is reproduced through dispositive and practices. Since the introduction of the sustainability concept into BMBF funding and the first edition of FONA, institutional structures have been built in the responsible Sustainability Subdepartment: a dispositive with FONA as corresponding programme, and administrative structures that guide further developments:

> "If you compare FONA2 and the organisational structure of the ministry, you notice quickly that it is a continuation of the previous programme. No paradigm change occurred based on insights during the first five years. The programme is a continuation of the status quo of the first programme period. Five or six units were responsible for FONA, had their own insights and developed an own handwriting. FONA2 adds up what the five existing units of the subdepartments were doing." (PA14)

In conclusion, the uptake of sustainability as a concept within the BMBF and more specifically with FONA as an accompanying funding programme was inspired by the external discourse on sustainability. A combination of multiple factors helped the new sustainability discourse in becoming the dominant paradigm in environmental research funding, culminating in the emergence of FONA: The rise of sustainability as a concept in international public debates; changing public perceptions and rising demands for political action which were taken up by policy makers; a change in political leadership within the BMBF. In centring funding on sustainability as a *leitmotif*, the Sustainability Subdepartment drew on a politically opportune idea which had already begun to institutionalize itself in public discourse as well as in international politics, such as in corresponding international agreements and in public discourse. As an encompassing concept, sustainability also provided a coherent frame for previously scattered BMBF activities, which was an added benefit in view of legitimation and external visibility (interview with PA04).

Nevertheless, interviewees also emphasize the important role of individual actors. Both external actors as well as actors from within the BMBF acted as change agents. As supporters of the sustainability discourse, they were able to form a discourse coalition on sustainability and thereby act as game changers: "In that phase of Brundtland and Rio there were some young people in the government who thought in that direction. Within a whole movement, individual people are important to move topics." (PA12) The quote enhances the notion of the duality of structure and agency underlying discourse as conceptualized in SKAD. Without the bearers of a discourse who have agency and act as change agents, a new discourse will hardly be successful in institutionalizing itself.

8.2.3 Sustainability in FONA: Reinterpretations of a concept along economic criteria

In contrast to the BMBF's leitmotif of high-tech and innovation, the idea of sustainability is not an influential idea throughout the BMBF. While it serves as an overarching concept for the funding activities of the Sustainability Subdepartment, sustainability cannot be considered as a comparable core value or guiding discourse of overall BMBF policies.

The BMBF's economy-oriented core discourse influences the ministry's conception of sustainability. It thus is a strong stimulus for the actualisation and reinterpretation of the sustainability discourse. As such, ideas incorporated in the High-tech Strategy are integrated in FONA. Since its first version in 2005, FONA portrayed "sustainability as an economic and innovation factor" (BMBF 2005a: 6). While the first edition of FONA (2005) evolved in parallel to and independent of the first High-tech Strategy (2006) (interview with PA14), as of its second edition FONA was explicitly set into relation with the High-tech Strategy's goals. The BMBF

claimed that FONA "implements the High-Tech Strategy in the field of 'Climate Protection/Energy'" (BMBF 2009a: 5–6).

The overall orientation of the BMBF towards technological development and economic growth thus turned into the fundament of the ministry's endeavours even in fields such as sustainability. The congruence of FONA and the High-Tech Strategy's objectives is not surprising from a SKAD standpoint. The core values of the BMBF trickle into all specialized science policy discourses.

There is no standard definition of sustainability or sustainable development – and no standard or commonly accepted way of achieving it. As in any discourse, different definitions coexist, covering a range of more radical concepts calling for radical changes in economic and social systems, towards ones that do not question current ways of consumption etc quote. It is a matter of power and of resources which definition is successfully established in policies and public (ch. 2.3; Voß et al. 2006; Voß 2013). In FONA, a politically suitable definition of sustainability developed. In SKAD terms, the discourse on sustainability was renewed and adapted within the BMBF in order to fit its leitmotif. Members of the working group that developed the first concepts for FONA point out that the initial draft of FONA and its underlying concept of sustainability had been much more radical in scope and that pursuing its objectives would have required institutional changes at a larger scale:

> "The result of the working group was that in order to reach a sustainable future for mankind and the earth, science, policy and funding would need to be redirected towards finding solutions quickly. However, this would have meant to reorganize the BMBF and redirect its policy as well. The report was never really considered and disappeared from the agenda." (PA14)

Pursuing a different discursive direction by developing policies for solution-oriented, non-technological research could have served to distinguish the BMBF from the Federal Ministry of Economic Affairs and Energy (BMWi), to which the BMBF lost its official responsibility for technology in 1998 (BMWi 2015). However, the BMBF did not let go of its general direction of an innovation-driven science policy oriented towards economic well-being, embedded in a dispositive of organisational shape, practices and prevalent ideas. The alternative discourse, built on the argumentation of orienting science policy towards the socio-ecological objectives of sustainable development, was not successful in establishing itself as the main objective of science policy, as interviewees remember (interview with PA14).[3]

Instead of undergoing the risk of an institutional re-orientation, the BMBF adapted the sustainability concept in order to suit its core discourse. Taking up, adjusting and interpreting the sustainability concept according to the own needs

3 However, the ideas remained alive within alternative discourse coalitions (ch. 7, Box 7-1).

was politically useful in different ways. Sustainability provided a coherent umbrella for previously isolated bits and pieces of funding in the field of environmental sciences. Rather than bringing radical conceptual changes, the sustainability discourse thereby provided a new frame for old problems. Striving for sustainability as an overarching concept legitimized funding and made activities more visible, while at the same time, the general direction of policy and funding did not have to change substantially in order to fulfil national and international obligations towards sustainability (interviews with PA04, PA12, PA14).

The High-tech Strategy and its underlying discourse of a science policy aimed at fostering an innovation and technology-driven German economy remain pivotal for the policy discourse on sustainability expressed in FONA. Economic wellbeing and growth through technology development are put into the centre of the BMBF's sustainability concept:

> "The concept of sustainable development is becoming an increasingly important economic factor. The High-Tech Strategy for Germany initiated by the Federal Government meets the global challenges. Protection of climate and resources has priority. Here, decisive key issues of the future are identified which lay the foundation for a competitive knowledge society." (BMBF 2009a: 5)

Aspects of sustainable development, such as climate protection, are thus not considered as a value as such, but as an instrument towards economic prosperity. As such, it is not surprising that the New High-tech Strategy (Bundesregierung 2014) explicitly includes Sustainable Economy and Energy as a priority field of action. A similar idea is expressed in the next statement, taken from the BMBF website:

> "With FONA, the national sustainability strategy and the new High-tech Strategy are put into practice. The objective is to strengthen Germany's position as a technological leader in the areas of climate protection and adaptation to climate change, sustainable resources management, and innovative environmental and energy technologies." (BMBF 2016d, *own translation*)

The quote illustrates that not only sustainability as such, but its potentials for German economic development are major motivations of FONA.

In contrast to the BMBF's conception, many scholars argue that sustainability in all its dimensions is not to be achieved without questioning the supremacy of economic growth, and thus perceive the combination of sustainability and economy-oriented innovation thinking as a paradox (ch. 2.3.2; among others Unmüßig et al. 2012; Martínez-Alier et al. 2010; Brand 2012; Göpel 2016). Based on similar arguments, within the German sustainability research community, researchers positioned themselves critically in view of future research topics for sustainability research and questioned the BMBF's stance on economic growth and sustainability (Grießhammer et al. 2012). The Sustainability Subdepartment seems to be aware

of the criticism but maintains its discourse on green growth, coupling economic growth and sustainability:

> "It is correct that applied research is closely oriented towards economically viable innovations. In my opinion it is wrong to criticize the focus on technological research, however. Rather, the economy-relevant topics should be directed towards sustainability. We have to prioritize transformation research in this area. We will only reach the guiding principle of sustainable prosperity with the economy, not by setting boundaries to it. That's why we feel so strongly about the connection of sustainability issues with economic innovation. We need the humanities for that, but civil society as well." (Huthmacher 2013, *own translation*)

The idea of a green economy is sustained as a basic assumption and objective throughout the most recent edition of FONA as well:

> „By fostering a closer collaboration between science and industry, FONA3 aims to support the Federal Government's recently declared objective in the HighTech Strategy of a green economy, which seeks to sever the link between economic growth and the use of resources." (BMBF 2015b: 7)

While FONA3 proposes to scientifically reflect on notions such as societal wellbeing, and thereby acknowledges the room for interpretation, the possibility of green growth and along with it the objective of FONA as such is not put up for debate or scientific analysis. *Qualitative growth* is introduced as a new related concept in order to explain how to reconcile economy and sustainability: "The goal of a green economy is the transition to sustainable business management, with practices that conserve natural resources and mitigate negative environmental effects, thereby facilitating qualitative growth." (BMBF 2015e: 10) The definition does not go into the details of what exactly *quality* signifies in view of growth, which per definition is a quantitative concept. Head of department Huthmacher, in a parliamentarian expert debate, made use of a similar line of argumentation: "A few words about the concept of sustainability. Maybe our definition is not state of the art. Qualitative prosperity and growth is now at the center of our self-perception, and it is part of and fed back to the High-tech Strategy." (17. Deutscher Bundestag 2012b)

Unfortunately, Huthmacher did not elaborate upon the concept of *qualitative growth* in this instance of discourse actualisation, either. It remains open how qualitative growth is to be achieved and how to distinguish it from quantitative growth. I'd like to argue that the introduction of well-sounding concepts such as qualitative growth is a strategy of discourse reproduction and legitimation. It preserves the BMBF's course of policies and actions in withdrawing from direct critique. *Empty signifiers* accomplish to pacify critics, while maintaining the status quo behind the façade.