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"Research & development for sustainable development: how European R&D activities and programmes contribute to SD"

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This ESDN Quarterly Report (QR) focuses on the role and potential contribution of research and technological development (R&D) in relation to sustainable development (SD). The first section explores selected issues related to science, knowledge, policy making and sustainability. By doing so, it takes a look at the history of the relationships between environmentalism, science and policy making, investigates the role science plays in evidence-based decision making, and describes the characteristics of sustainability science. The second part of this QR presents some main results as regards how research funded with the EU's seventh framework programme (FP7) contributes to the key challenges and operational objectives outlined in the EU Sustainable Development Strategy (EU SDS). It is based on the monitoring system www.fp7-4-sd.eu that has been recently set up by DG Research. The third section aims at providing an overview of how research and development (R&D) targets are being addressed in National Sustainable Development Strategies (NSDS) of EU Member States. The QR is concluded by outlining the attempts of two countries (Germany and Austria) in compiling and funding national research programmes for sustainable development.

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1 Science, knowledge, policy-making and sustainability

The aim of this introductory section is to explore selected issues related to science, knowledge, policy making and sustainability. In the first section we will take a look at the history of the relationships between environmentalism, science and policy making. Even though the ecological movement has often been "in hostile relationship with science" or at least technology (Foucault 1988a, p. 15), this relationship is far more subtle and variegated, and of significant importance to the structure of environmental governance. In the second section we will take a look at evidence-based decision making and at the role it formulates for science, and some of the associated aspects (assumptions about and rationales for the policy process, risks, tools etc.). The third section describes the characteristics of sustainability science, as in situations of high stakes as well as uncertainties caused by nonlinearity, complexity, and irreproducibility (Schellnhuber 2002), conflicting values, or urgency to act, a new kind of science is needed. Our description builds on the key features of governance for sustainable development formulated in our March 2010 ESDN Quarterly Report and returns to the relationships between environmentalism, science and policy making from the first section, charting several implications for the science-policy interface in the context of sustainability governance.

1.1 Science, society and modernity

Even though the modern administrative state emerges from the European medieval state of justice already during the 15th and 16th century (Foucault 1991, p. 102-103), the transition to what we could call the modern approach to steering occurred only towards the end of 18th century. Several developments were key in this respect. The "increases in agricultural productivity and availability of resources in Europe encouraged rapid demographic growth, and accompanied greater security from starvation and disease" (Rutherford 1999, p. 42) as well as provided a foundation for rapid industrialisation and the rise of modern capitalism. Secondly, the ideal of societal steering as management based upon scientific understanding of the population and the environment became possible with the significant advances made in science during the 18th and 19th century – in biology, geography, demography, agriculture, social welfare and public health (hygiene, nutrition, mental health). It is at this point when "*the idea of a measurable and manageable population comes into existence, but so also does the notion of the environment as the sum of the physical resources on which the population depends*" (ibid., p. 39). The so-called 'population-resources problem' became the central theme of 19th century environmental discourse[1] (ibid., p. 52), with the task of the state involving the supervision of the 'living interrelations' between these two living entities (Foucault 1988b, p. 160).

Science became indispensable in this new type of steering. We already hinted that "the task of administration rested above all on ever more detailed knowledge of the resources of the state, including all the characteristics of its population and particularly knowledge of geography, demography, natural resources, agriculture, climate, etc." (Foucault 1991, p. 93-95, in Rutherford 1999, p. 47). "Modern thinking about the environment is characterized by the belief that nature can be managed or governed through the application of the scientific principles of ecology" (Rutherford 1999, p. 37) and science provided the "ability to distribute, classify, analyse and spatially individualize the objects dealt with" (de Certeau 1984, p. 46), both in regards to the population and the environment.[2] "Scientific ecology has become a political resource that in important respects constitutes the objects of government and, at the same time, provide the intellectual machinery essential for the practice of such government" (ibid., p. 37). As a result, environmental knowledge became instrumentalised and subordinated to a technocratic ideal of administrative practices, becoming a vehicle for issues of "(state) 'security', techniques of control of the population, and new forms of knowledge (*savoirs*)" (Darier 1999, p. 22).[3] Ecology becomes "a rationale behind a *new form of political economy*" (Rutherford 1999, p. 54).

For modern steering the deployment of a new type of power is critical. This power relies on developments along three axes: institutional centralization around governmental agencies; the emergence of new instrumental knowledge; and the "capillary diffusion of power effects

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[1] Linking diverse strands originating in the ideas of e.g. Malthus, Darwin, Mill, Haeckel, forestry, colonial environmental management etc. (see Bramwell 1984, p. 91-100).

[2] The "definition and administration of populations simultaneously requires the constitution and management of the environment in which those populations exist and upon which they depend" (Rutherford 1999, p. 39).

[3] State intervention (in the form of environmental legislation and enforcement agencies) intensified since the end of the 1960s, with science playing a variegated role. For example, at the international level, environmental problems and policies have been identified and framed with a strong involvement of scientists (see the work on epistemic communities by Haas (1992; 2004)). Another example made Cramer *et al.* (1989, p. 96-97) shows how environmental concerns have even been partially formulated to reflect the professional interests of scientists. Here the observations of Birkland that "the group that successfully describes a problem will also be the one that defines the solutions to it" (2007) and of Schattschneider that "the definition of alternatives is the choice of conflicts, and the choice of conflicts allocates power" (1968, p. 68) are relevant. Scientists and their organisations thus become important actors in policy processes, initiating or shaping policy responses. In addition to that, science plays a role of epistemic policing, defining what is to count as scientifically acceptable knowledge of the natural world. In particular environmental governance in advanced liberal societies "is [thus] far more dependent on the role played by scientific expertise in defining and managing environmental problems than the more traditional state-centric notions of politics and power would suggest" (Rutherford 1999, p. 37) and "widespread reliance by the state on extensive systems of scientific advisory structures [has] become an integral feature of environmental (and health) policy making in industrialized societies" (ibid., p. 55). It is worthy of note that this reliance has also a complex influence on public administration; e.g. different policy tools chosen in policy design (i.e. the definition of alternatives) "require distinctive sets of management skills and knowledge, thus the choice of tools ultimately influences the nature of public management" (Sidney 2007, p. 83).

across the entire social body" (Darier 1999, p. 23), i.e. becoming increasingly pervasive in its 'acting directly on the body of the individuals' (in areas of e.g. lifestyles and consumption patterns, hygiene or health). It would be too hasty to perceive this power in purely negative, coercive or repressive terms.[4] In addition to its disciplining and cohesion-ensuring function executed through 'continuous regulatory and corrective mechanisms', power also has a constitutive and enabling function, embodied in the discourse, legislation and organisation on public right (Foucault 1976, p. 144; see also Lanthier & Olivier 1999, p. 70). Knowledge through power to 'quantify, measure, appraise and hierarchise' is pivotal for both of these functions; steering thus becomes reliant on 'a series of expert knowledges' (Rutherford 1999, p. 41).[5] Since modern liberal democracies rest on the marriage between "more or less formalized bodies of knowledge and specific administrative mechanisms" (ibid., 50), science – as a "historically specific, coherent configuration of how knowledge is organized" (Darier 1999, p. 9) – becomes, since the end of 19th century, inextricably linked to the exercise of power.[6]

Although the described phenomena can be seen as continuing until today, since the end of the 1950s we also observe another qualitative change in the status and role of knowledge in post-industrial, decentralised and globalised societies, where fundamental transformation of the capitalist mode of production and of labour have occurred. It is increasingly perceived that the scientific agenda (tied to the global processes of modernisation and rationalisation) may itself contributed to fuelling processes of ecological destruction and poverty and inequality, expressed in the concern that scientists are the problem, not the solution (Dasgupta 2000), and that solutions to prior problems later become new, and more difficult, problems (e.g. nuclear power, microbiology). This is also related to the risk society of Ulrich Beck and the increasing acknowledgement of complexity and uncertainty: "while our knowledge continues to increase exponentially, our relevant ignorance does so even more rapidly" –"this is ignorance generated by science" (Ravetz 1987, p. 100, in Darier 1999, p. 2). "The absence of obvious credible solutions and the knowledge to implement them sustain concerns and anxiety for the environment", resulting in "proliferation of discourses about the environment from most quarters of the society" while at the same time resulting in a "general increase in scepticism about scientific knowledge" (Darier 1999, p. 2) and diminishing of trust into the institutions of science even despite (or due to) their role as a driver of technological innovation. Darier adds that "at least since Thomas Kuhn (1962), there has generally been less confidence that scientific knowledge and technological innovations are the necessary conditions for human betterment" (ibid.). Lyotard suggests that recent forms of knowledge (in natural and social sciences, in politics) cannot anymore make explicit appeals to universal standards, and particularly the progress in sciences produces an

4 Gordon also interestingly observes that the policing state is simultaneously also the 'state of prosperity' (1991, p. 10).

5 Devall and Sessions show how the management ideal based on a problem-solving rationale relates to creation of this 'series of expert knowledges' in the following quote (1985, p. 146): "[I]ncreasingly intensive management produces a host of unintended consequences which are perceived by the managers and the public, and specially by the environmental/ecology movement, as real and severe problems. The usual approach, however, is to seek more intensive management, which spawns even more problems. And each of these problems is seen as separate, with separate experts and interest groups speaking to each other across a chasm of different technical vocabularies."

6 Lyotard describes how decision makers "allocate our lives for the growth of power"; "[i]n matters of social justice and of scientific truth alike, the legitimation of that power is based on its optimizing the system's performance – efficiency" (1984).

'incredulity toward grand narratives' (Lyotard 1984, p. xxiv). Some scholars go as far as to say that in societies "characterised by an increasing intensity and speed of reflexive mechanisms (...) the result of [reflexive] processes might establish new relationships that undermine the existing knowledge" and as a result, "[s]ocial reality has then become unpredictable in principle" (in't Veld 2010, p. 2). "As knowledge production grows, society learns to respond more quickly with a potential negation of that knowledge as a consequence" – "[s]ociety can undo knowledge about itself" (Basten 2010, p. 75). Postmodern society is therefore characterised by 'radical heterogeneity' and "decline of ideological hegemony in politics and social life" (Dickens & Fontana 1994, p. 4), even, as Bell argues, "the dissolution of shared moral order" (ibid., p. 9).

Eroding trust in scientific knowledge gives more space to other types of knowledge. "Internet, better education and other societal changes have made knowledge accessible to many more people than in the past", leading to **'citizens' knowledge'** (in't Veld 2010, p.5; see also Lyotard 1984).[7] This would correspond with the developments toward governance described by Turnhout as "a trend away from hierarchical command and control modes of steering towards civil society participation and the use of voluntary and market-based instruments", creating spaces where "[p]articipants engage in Habermas-inspired deliberations and achieve communicative rationality", and transforming organisation of societies away from hierarchies toward "horizontal networks of connected, free and equal actors" (2010, p. 31). In the science-media-politics triangle changes in each of the peaks have been observed – from disciplinary science :: top-down media :: representative democracy to emerging transdisciplinary design/science :: emerging bottom-up media :: emerging participatory democracy (in't Veld 2010). It is obvious that this development requires an adequate incorporation of the different types of knowledge produced by different actors and in different processes than in science.

1.2 Scientific evidence and policy making

Evidence-based decision making (also called *fact-based decision making* or *evidence-based policy making*) is a concept which relatively recently became popular in public (particularly in the field of public health) and private decision making. It refers to use of evidence (produced by science, but also by professional evaluation and other tools, see below) in decision making – either to make, inform or support a decision (see e.g. Tingling & Brydon 2010). Evidence-based decision making attempts to link knowledge and policy (in other words, providing evidence is a way of transforming knowledge into policy making) to make policies more effective, manage risks (see e.g. the discussion on the precautionary principle), achieve transparency, strengthen accountability and support learning. Nevertheless, its underlying understanding of transparency, legitimacy and efficiency/effectiveness is, as in the case of

[7] It has also been suggested that these patterns typical for Western science/policy interface and the role of mainstream scientific knowledge (especially at the national level) might not be that relevant to other levels of social organisation, where small-scale traditional societies „base their decisions on traditional ecological knowledge (...) and analogous modes of thinking applicable to other issue areas" (Young 2006:849-850). The importance of local knowledge or contextual knowledge in contrast to the scientific knowledge as a particular form of knowledge has also been stressed by e.g. Ostrom (1990) or Fischer (2000). Above we have also already shown the importance of 'epistemic policing' and definition of permissible knowledge, which is conducted by the same institution as the institution producing knowledge (i.e. science). In this vein Young further states that "the task of developing a consensus regarding the state of knowledge pertaining to global concerns such as climate change or the loss of biological diversity is not an easy one" (2006).

results-based management[8], inspired by 'neo-liberal or managerial governance ideals' (Turnhout 2010, p. 35), based on an implicit top-down perspective and an idealised rational problem-solving and instrumental approach to policy making[9]. As such, it can be understood as a particular expression of the modernist approach to steering and the relationship between knowledge and steering, as explored in the first section of this introduction.

The managerial ideal assumes an information deficit and that more information will lead to better decision-making.[10] The model of 'speaking truth to power' (Wildavsky 1979) "is a linear model that assumes one-way traffic of truth from science to policy and separate domains of production and use of knowledge" (Turnhout 2010, p. 26). Knowledge as an input into the decision-making process is considered to be value-free and objective (which should be ensured by the attendant structure of science), demand-oriented and to serve, in its ideal form, as a true image of the world with all its causal relationships which are relevant for decision making. "Effectiveness [of policy interventions] is assured as the knowledge concerns true statements on the relationships between political interventions and their societal effects" and "legitimacy is furthered when the policies are based upon the 'objective' truth" (in't Veld 2010, p. 6). We have already shown how such expectations are unrealistic.

These ideals are particularly visible when evidence is supposed to be used to **make a decision**, i.e. evidence and the (scientific) processes creating it represent the only meaningful input into decision making. Such an arrangement creates knowledge elites and is typically termed as technocratic (meaning that policy decisions depend on superior knowledge provided by experts).[11] Policy formulation has for a long time had a back-room function in arenas which were not visible or open to the public, such as government bureaucracies, interest group offices or think tanks (Sidney 2007); however, "national policy ... increasingly finds policy formulation to occur outside of government offices – that is, in think tanks and within the loose networks of advocacy and interest groups that together with government officials make up policy communities" (ibid., p. 86).

When we say that evidence is **informing a decision** we on the other hand means that scientific knowledge/evidence is one of several inputs into decision making (the other types

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[8] Evidence-based decision making is related to *result-based management* (RBM, also called *performance management*) which in the context of public policy means demonstrating achieved value for spent public money. RBM is considered to be one of the features of New Public Management, one of the three major eras of governance, promoted as 'rationalisation' and 'de-ideologisation' of government, where in fact it represented a colonisation of government practice by economic categories (efficiency, 'doing more with less', customer orientation, benchmarking and performance monitoring, etc.). RBM is closely linked to evaluation and life-cycle approach to policy planning; it is, nonetheless, relying on professional consultancy rather than institutionalised science, and although methods of particularly social science research get frequently utilised, they often do not live up to standards of scientific quality (cf. OECD 2001). RBM was increasingly utilised among the OECD countries in the 1990s and later promoted within the UN system especially in relation to evaluation of programs of development assistance.

[9] The guiding metaphor for policy as problem solving is the policy cycle, based upon the regulatory cycle from engineering (Crabbé & Leroy, p. 26; see also Sabatier & Mazmanian 1979).

[10] In the ESDN Quarterly Report from March 2010 we suggested that "when dealing with societal transitions of such a large scale and scope as the sustainable development project implies, **policy making by necessity meets 'wicked problems'**", which manifest *inter alia* the feature of ambiguity: "[t]he problem with ambiguity is not that the real world is imperfectly understood and that more information will remedy that" (Weick 1995). The very nature of deeply complex problems implies that more knowledge (produced and used within existing structures) does not necessarily translate into higher quality of decision making.

[11] There is also a debate about whether such a strong decision-support impinges on the political mandate of the decision makers.

of input being e.g. participatory processes and local knowledge, negotiation/bargaining or values/ideologies; see also JRC & AAAS 2009, p. 6, and Lindblom & Cohen 1979, p. 10-29). It needs to be, however, pointed out that seeing science as monolithic in this respect would be an oversimplification: "[p]olicy makers have **multiple sources** of solicited and unsolicited science advice, thus science does not necessarily speak with one voice" (JRC & AAAS 2009, p. 7). Various scientists can be involved in various policy communities and knowledge coalitions with differing vested interests. In addition, the same piece of evidence can be used (framed, interpreted) to support differing interests, which often happens in contested issues such as climate change, smoking and lung cancer, chemicals, GMOs etc.

The most perilous type of evidence usage is to **support** (justify) **an already made decision**. Scientific (or other) evidence is produced after the decision is made to retroactively increase accountability for the decision, silence critics or shift responsibility. Among the obvious dangers are selective commissioning and publishing of research (see e.g. UK House of Commons 2006, p. 49-50) as well as politicisation of science: the "power and influence of politics tends to infect the procedures and processes of knowledge production of science, to its detriment, and […] to the detriment of the public interest" (UK House of Commons 2006, p. 46-47; see also Dasgupta 2000).

Evidence-based decision making goes hand in hand with developments in tracking of the performance of the public sector. Numerous **tools in support of evidence-based decision making exist**: assessment tools, measurement and indicator systems, scenarios, appraisal, results-based budgeting, evaluation and reporting tools etc. European Commission's Impact Assessment procedures as well as various other forms of impacts assessment (Regulatory Impact Assessment (RIA), health impact assessment, social impact assessment, environmental impact assessment (EIA), strategic environmental assessment (SEA), sustainability impact assessment) are of rising prominence.

As stated above, scientific advice typically has a strong role in evidence-based decision making. In the UK, the House of Commons recommended that science and evidence be put "at the heart of policy making" (2006, p. 10) and that scientific expertise should "be used to the maximum level possible" (ibid., p. 11), including in processes of risk assessment. This would require "greater public investment in research to underpin policy making and ... [funding of] independent policy-related research" (ibid., p. 3). Independence from political interests is one of the structural features of the institution of science different from policy, expected to counterbalance some of the more interest-driven features of policy making – similarly, science has a role to "combat the short-term nature of the political cycle" (p. 3). Critics, however, point out that such a role for science is not entirely feasible: i) "scientific knowledge by its very structure never directly relates to action, because it is fragmented, partial, conditional and immunised" (in't Veld 2010, p. 10); and ii) there is "an incompatibility between the ideology of evidence-based policy and the natural inclination of the political process to want to secure the best outcomes" (UK House of Commons 2006, p. 45). This is supported by the findings of the survey conducted by DG Research, Social Sciences and Humanities, which conclude that scientists see the impact of (EU-funded) research on policy making as too low (EC 2001, see also Turnhout 2010, p. 25). Contrary to conventional wisdom, policy makers are not influenced by single studies or reports and elements of the policy process not related to problem-solving tend to be systematically ignored (Jann & Wegrich 2007), perhaps because "[p]otential knowledge users can have well-grounded and justified reasons to reject scientific knowledge", including reasons stemming from "a justified lack of trust in the knowledge-producing institutions" (Turnhout 2010, p. 26; see also above).

It is increasingly being acknowledged that science is a "cultural, social activity permeated with values and preferences" and as such "not essentially different from other cultural practices – including policy – [having] no privileged, unmediated access to the truth" (ibid.).

1.3 Sustainability science

As argued above, "science is in need of a new legitimacy and requires a new appealing vision for the relationship between knowledge production and use" (Turnhout 2010, p. 26). We suggest that sustainability science is well suited to serve in this respect. Sustainability science is an emerging field of scientific study, however not yet fully established and autonomous. It is, however, already "bringing together scholarship and practice, global and local perspectives from north and south, and disciplines across the natural and social sciences, engineering, and medicine" (Clark & Dickson 2003) "to produce understanding that is true for specific places" (Clark *et al.* 2005, p. 17). Sustainability science is supposed to achieve comprehensive understanding of complex problems and help policy address them. Komiyama and Takeuchi, editors of the recently launched academic journal *Sustainability Science*, write in the first issue: "[i]t is our belief that this research can help resolve one of the fundamental dilemmas of contemporary scholarship – the inability of our overly specialized disciplines to offer comprehensive solutions to the conditions that threaten the sustainability of global, social, and human systems" (2006, p. 5). In the following, we will describe key features of the emerging field of sustainability science.

Sustainability science is supposed to be socially oriented (engaged) and demand-driven instead of purely academic, and trans- and interdisciplinary instead of mono- or multidisciplinary[12] (Funtowicz & Ravetz n.d.; Martens 2006). This is confirmed by Blackstock *et al.*, who describe sustainability science as "embedded within broader social processes of understanding and applying sustainability, thus sustainability science contributes to socio-political decision making processes through information provision (especially analyses of risks and consequences) derived from emergent interdisciplinary inquiry" (2007). Interdisciplinarity, however, is a challenge to the established disciplinary boundaries of science, which on one hand isolate individual disciplines and make transfer of approaches and solutions problematic, but on the other hand provides an attendant structure for academic careers (journals and their impact factors, academic chairs etc.). Seager confirms that "[t]he overwhelmingly dominant approach [in science] has been reductionist, which requires isolation of system components for independent investigation" (2008, p. 446). Rather than examining each system independently, sustainability science focuses on the interactions between human and natural systems, examples of emerging areas being ecological economics, industrial ecology, ecosystem health, political and social ecology, system dynamics, sustainability governance, sustainability evaluation research, and sustainable decision making, management, policy and design (ibid., p. 447-449). Another feature of sustainability science which makes it difficult to fit within existing disciplinary

[12] **Monodisciplinarity** refers to the pursuit of knowledge and study of a subject using theories, methods and approaches from one scientific discipline; **multidisciplinarity** refers to a study of the subject which attempts to provide more insight through presenting side-by-side results of examination by two or more disciplines; **interdisciplinarity** refers to integration through transfer of theories, methods or approaches between two or more disciplines, producing findings which would not be autonomously reachable by individual disciplines; **transdisciplinarity** refers to creating wholly new frameworks out of the building stones provided by individual disciplines.

structures is that it represents "neither 'basic' nor 'applied' research", but rather "use-inspired basic research" (Clark 2007, p. 1737).

As suggested above, in addition to the challenges of inter- and transdisciplinarity sustainability science should strive to be participatory (i.e. achieving co-production of knowledge) instead of technocratic; increasingly used is also the term *civic science* (Bäckstrand 2003) or *democratic science*. Sustainability science tries to enlarge the role of the citizens in various steps of the production and usage of scientific knowledge with the goals of restoring public trust in science, re-orienting science towards coping with the complexity of sustainability problems and installing democratic governance of science (ibid.; see also Blackstock *et al.* 2007). The participants of the *Friibergh Workshop on Sustainability Science* which took place 11-14 October 2000 similarly stated that sustainability science needs "to be able to involve scientists, practitioners, and citizens in setting priorities, creating new knowledge, evaluating its possible consequences, and testing it in action". Clark *et al.* even suggest that stakeholder dialogue is "the prime mode of holistic knowledge production" (2005, p. 11; see also O'Riordan *et al.* 1999). However, "power is usually lacking in discussions about governance and participation" (Turnhout 2010, p. 31). Returning to topic of power and knowledge from the first section, we find the following quote by Turnhout relevant (ibid., p. 32): "[T]he public is not a pre-existing entity waiting to be involved; it is brought into being – performed – in the context of participation. Participatory initiatives are sites of power in the sense that they create their own participants in ways that fit with the objectives and expectations of the initiators. (...) There is little room for deviation. Actors who do not fit the requirements or expectations, who lack the skills and competences to use information or participate in knowledge production, or who wish to refrain from involvement will become effectively marginalised."

Sustainability science is also based on acknowledging complexity and uncertainty and as such fulfilling an exploratory and learning-oriented role (Funtowicz & Ravetz n.d.; Martens 2006). Clark *et al.* suggest that "a final insight to emerge from the last decade's reconsideration of the role of science in achieving sustainability is a shift of emphasis from the importance of 'knowing' to the centrality of 'learning'" (2005, p. 17). Martens suggests that among the central elements of sustainability science there are also 'learning through doing and doing through learning' as well as 'system innovation instead system optimization' (2006, p. 38). Similarly the participants of the *Friibergh Workshop on Sustainability Science* suggest that "[t]he common sequential analytical phases of scientific inquiry such as conceptualizing the problem, collecting data, developing theories and applying the results will become parallel functions of social learning, which incorporate the elements of action, adaptive management and policy as experiment" (2000).

Pim Martens also suggests that sustainability science in effect requires a new paradigm "that is better able to reflect the complexity and the multidimensional character of sustainable development" and which "must be able to encompass different magnitudes of scales (of time, space, and function), multiple balances (dynamics), multiple actors (interests) and multiple failures (systemic faults)", with the theory of complex systems being suggested as the "umbrella mechanism to bring together the various parts of the sustainability puzzle" (2006, p. 38).

Since sustainability science is still in flux, it is too early to foresee the scope of its core questions, mechanisms and criteria for quality control, as well as institutional structures (Clark & Dickson 2003). The participants of the Friibergh Workshop on Sustainability Science foresaw that "sustainability science will ... require new styles of institutional organization to foster and support inter-disciplinary research over the long term; to build capacity for such research, especially in developing countries; and to integrate such research in coherent systems of research planning, assessment and decision support" (2000). It is also yet unclear whether sustainability science will be one 'metadiscipline', or several sciences of sustainability (for examples of areas see above).

Science of sustainability can contribute to the societal task of transition to sustainability through: i) producing knowledge on the interactions between socioeconomic and natural systems: stocks, flows, performance; ii) producing knowledge on the management of the transition: actors, incentives and institutions; iii) becoming part of the transition process: boundary spanning between science and policy, achieving mobilisation, participation, empowerment and capacity building (see also Komiyama & Takeuchi 2006, p. 5); iv) self-reflection: identification and utilisation of the means of improvement to fulfil the first three roles (infrastructure, institutions for integrative research, skills to conduct participatory research, networking etc.). These four roles are depicted in Figure 1 below.

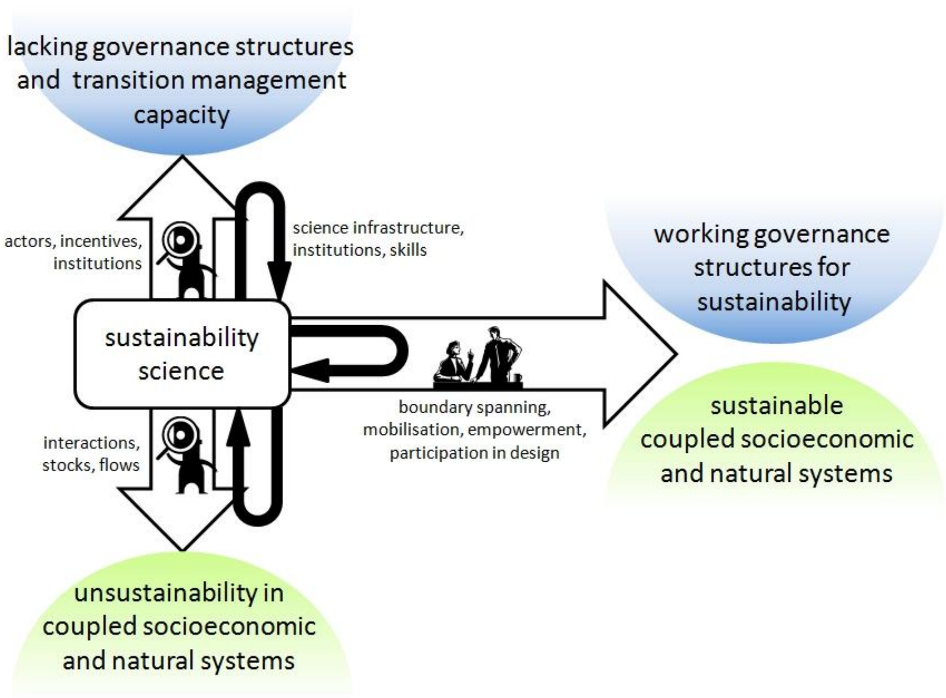


Figure 1: The four roles of science of sustainability

Sustainability science should represent a possibility of achieving a new consensus on "what knowledge is, what it means to use it effectively and how it should be transformed into action" (Turnhout 2010, p. 32) and thereby contribute to 'knowledge democracy'; however, we need to be continuously aware that "knowledge generation is inextricably embedded in the cultural-historical context" (Clark *et al.* 2005) and that "environmentalism is itself a normalizing discourse, and thus produces specific power relations, rather than eliminates them" (Sandilands 1999, p. 80).

2 Contribution of FP7-funded research to the EU SDS key challenges: general overview & analysis by EU SDS key challenge

This section provides a brief analysis of how the EU’s main research programme, the Seventh Framework Programme for Research and Technological Development (FP7), contributes to the key challenges and objectives laid down in the European Union Sustainable Development Strategy (EU SDS) from 2006 (for a detailed overview of the EU SDS and its objectives and targets, see the ESDN Quarterly Report May 2006). First, the FP7 and its main thematic areas will be introduced. Then, the methodology behind the monitoring system FP7-4-SD.EU that has been developed on behalf of DG Research will be outlined. Finally, the results of the analysis of the FP7 Work Programmes covering the period 2007-2010 will be presented.

2.1 The EU’s Seventh Framework Programme for Research and Technological Development (FP7)

Since 1984, the so-called “Framework Programmes” have been the main instrument for funding research in the European Union. The 7th Framework Programme (FP7) is the current framework programme, running for seven years from 2007 to 2013 with a total budget of over € 50 billion. Compared to previous framework programmes, FP7 is the most comprehensive one both in terms of lifespan and funding. Compared to its predecessor, the FP6 which ran from 2002 to 2006, the FP7 budget represents a 63 % increase (at 2007 prices).

The FP7 is in general aimed at contributing to both the Lisbon Strategy (and its successor, the “Europe 2020” strategy) and the EU SDS, the two main EU policy strategies. The FP7’s general main objectives were outlined in the Commission’s impact assessment and ex-ante evaluation of FP7 (European Commission 2005), i.e. to contribute to meeting the EU’s policy objective to become the most competitive and dynamic knowledge society in the world and to invest 3 % of the EU’s GDP in R&D by 2010 (“Barcelona goal”). More detailed objectives that were also outlined include:

- To enhance the competitiveness of European industry by the common technology initiatives;
- To increase European S&T collaboration and networking for sharing R&D risks and costs;
- To improve the coordination of European, national and regional research policies;
- To strengthen the scientific excellence of basic research in Europe through increasing coordination and competition at the European level;
- To promote the development of European research careers and to make Europe more attractive to the best researchers;
- To provide the knowledge-base needed to support key Community policies;
- To increase availability, coordination and access in relation to top-level European scientific and technological infrastructure.

The FP7 budget will for the most part be spent on so-called ‘indirect actions’, that is, grants to research actors from across Europe (and beyond), with the aim of co-financing research, technological development and demonstration projects. These grants are provided on the basis of highly competitive calls for proposals (published in annual Work Programmes) combined with subsequent peer review processes which also include an ethical review. The remainder of the FP7 budget is spent on so-called 'direct actions' referring to the (non-nuclear) activities implemented by the Joint Research Centre (JRC), a research based policy support organisation which – as integral part of the European Commission – provides scientific advice and technical know-how to support a wide range of EU policies.

'Indirect actions' are grouped into four so-called "specific programmes" and constitute the bulk of the available FP7 budget. The specific programme (SP) 'Cooperation' is at the core of FP7 and represents about two thirds of the overall budget, followed by the SP's 'Ideas', 'People' and 'Capacities'. The four specific programmes will be presented in more detail below.

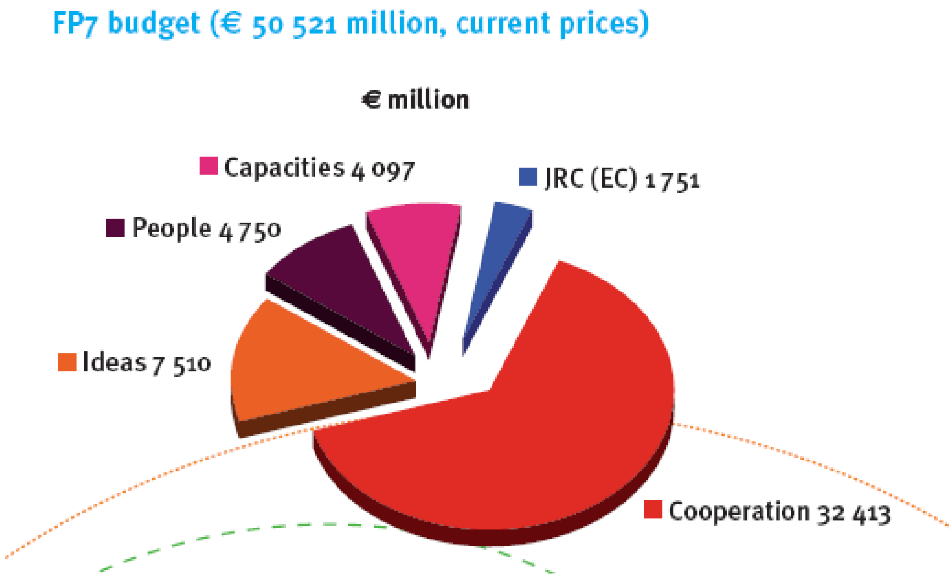


Figure 2: FP7 budget distribution (source: European Commission, 2007a)

Complementing the activities of the FP7, although legally separated from it, the European Atomic Energy Community (Euratom) has its own multiannual framework programme for nuclear research and training activities (Euratom FP7), running from 2007 to 2011 with a budget of € 2.7 billion. Similar to the FP7, the Euratom FP7 includes 'indirect actions' based on calls for proposals and 'direct actions' referring to the (nuclear) activities of the JRC.

Overall, the following "specific programmes" (SP) constitute the **five major building blocks of FP7** (including Euratom FP7). The SP's correspond to the main areas of EU research policy and work together to promote and encourage the creation of European poles of (scientific) excellence:

- **Cooperation**
  The SP Cooperation is at the core of FP7, representing two thirds of the overall budget. It fosters collaborative research across Europe and other partner countries through projects by transnational consortia of industry and academia. Research is carried out in ten key thematic areas "corresponding to major fields of knowledge and technology, where the highest quality research must be supported and strengthened to address European social, economic, environmental and industrial challenges" (European Parliament and European Council, 2006). **The overarching aim of the**

Cooperation programme is to contribute to sustainable development, by funding research in the following themes:

- Health
- Food, agriculture and fisheries, and biotechnology
- Information and communication technologies
- Nanosciences, nanotechnologies, materials and new production technologies
- Energy
- Environment (including climate change)
- Transport (including aeronautics)
- Socio-economic sciences and the humanities
- Space
- Security

- **Ideas**
  The programme Ideas supports "frontier research" solely on the basis of scientific excellence. Research may be carried out in any area of science or technology, including engineering, socio-economic sciences and the humanities. In contrast with the Cooperation programme, there is no obligation for cross-border partnerships. Projects are implemented by "individual teams" around a "principal investigator". The programme is implemented via the new European Research Council (ERC).

- **People**
  SP People provides support for researcher mobility and career development, both for researchers inside the European Union and internationally. It provides fellowships and other measures to help researchers build their skills and competences throughout their careers.

- **Capacities**
  The Capacities programme strengthens the research capacities that Europe needs if it is to become a thriving knowledge-based economy. It covers the following activities:
  - Research infrastructures
  - Research for the benefit of SMEs
  - Regions of Knowledge
  - Research Potential
  - Science in Society
  - Specific activities of international cooperation

- **Nuclear research**
  The programme for nuclear research and training activities covers the following themes:
  - fusion energy research (mainly with regard to the realization of ITER)
  - nuclear fission and radiation protection

As FP7 is designed to complement national research programmes, activities funded within FP7 are subject to meeting certain criteria in order to show a "**European added value**". One of these key criteria is transnationality: research projects need to be carried out by consortia which include participants from different European (and other) countries; fellowships in FP7 require mobility over national borders. By promoting transnational research, FP7 seeks to counter the fragmented nature of the European research landscape (European Commission, 2007a).

In principle, FP7 is open to participation from any country in the world. However, participation procedures and funding opportunities vary for different groups of countries. EU Member States and countries associated with FP7 (i.e. countries paying a share to the overall budget of FP7)[13] enjoy the broadest rights and access to funding. The so-called "International Cooperation Partner Countries" (ICPC) (e.g. Russia and other Eastern European and Central Asian states, developing countries, Mediterranean partner countries, etc.) constitute another important group of countries entitled to participate in FP7. Cooperation with these so-called "third countries" is explicitly encouraged in FP7, with the aims of:

- "to support European competitiveness in selected fields through strategic partnerships with third countries, and initiatives that encourage the best third-country scientists to work in and with Europe;
- to address specific problems that either have a global character or are commonly faced by third countries, on the basis of mutual interest and mutual benefit." (European Commission, 2007a)

Participation in FP7 is open to a wide range of organisations and individuals from the above mentioned countries, including:

- research groups at universities or research institutes
- companies intending to innovate
- small or medium-sized enterprises (SMEs)
- SME associations or groupings
- public or governmental administration (local, regional or national)
- early-stage researchers (postgraduate students)
- experienced researchers
- institutions running research infrastructures of transnational interest
- organisations and researchers from third countries
- international organisations
- civil society organisations (European Commission, 2007a).

2.2 Monitoring the FP7 contribution to sustainable development

In order to assess how research funded within FP7- in particular from the Specific Programme 'Cooperation', given its overall aim of "contributing to sustainable development" – contributes to the key challenges and objectives of the EU SDS, a monitoring system was set up by the Vienna University of Economics and Business (WU Vienna) in cooperation with Delft University of Technology (TU Delft) and maystorm software GmbH on behalf of DG Research. Since April 2010, the results of the monitoring of all Work Programmes published

[13] The following countries are associated to FP7 via so-called "third country agreements": the EU candidate countries (Croatia, the Former Yugoslav Republic of Macedonia, Turkey), the EFTA countries (Iceland, Liechtenstein, Norway, Switzerland), as well as Albania, Bosnia & Herzegovina, Montenegro, Serbia, the Faroe Islands and Israel (European Commission 2010a)

so far under FP7 (i.e. the Work Programmes 2007-2010) are available to the public via the public platform www.fp7-4-sd.eu.

The monitoring system consists of two main elements: (i) scientific evidence-based screening, and (ii) a public platform allowing users to interactively analyse the results from various points of view. These two main parts and the methodology behind them will be described in detail below.

Scientific evidence-based screening

The monitoring system combines two main features of European policy: The FP7 on the one hand, with its themes and activities (mainly from the 'Cooperation' programme), and the key challenges and objectives of the EU SDS on the other. In order to make this combination operational, a **qualitative text analysis of the topic descriptions** (a 'topic' is the most precise point of the hierarchy applied within FP7, outlining the needs, aims and expected impacts of the research to be undertaken concerning a specific issue) that are published in the annual FP7 Work Programmes has been undertaken. The key challenges and operational objectives specified in the renewed EU SDS of 2006 have in this regard been used as a referential framework.[14]

The initial screening was conducted by experts from WU Vienna and TU Delft, with the aim of identifying positive (i.e. supporting the EU SDS objectives), negative (i.e. conflicting with EU SDS objectives) or undetermined (i.e. impacts which due to a lack of scientific evidence cannot yet be categorized as positive or negative) expected impacts. In order to ensure the quality and accuracy of the identified impacts, some 10 % of the topics (including those having negative or undetermined impacts) were additionally validated by thematic experts from Ecologic Institute, INFRAS Research & Consulting, and ISI Fraunhofer.

When interpreting the results of the monitoring system, it is important to keep in mind that the results are based on ***ex-ante*** **evaluations of expected impacts** specified in the topic descriptions, and must not be understood as *ex-post* impact assessments of projects that are or have actually been carried out under a particular topic. However, as FP7 comprises a peer review process which ensures that the projects selected for funding actually meet the expected impacts outlined in the topic descriptions, the results provided by the monitoring system can nevertheless be seen as a "proxy" of actual impacts.

For a more detailed description of the methodology behind the scientific evidence-based screening, please consult the monitoring system's website www.fp7-4-sd.eu.

Interactive database at www.fp7-4-sd.eu

In order to make the results of the monitoring system available to the public, to allow customized analyses according to the interests of individual users, and to stimulate a public debate on particular issues, a public platform has been set up at www.fp7-4-sd.eu that – as

[14] In addition to the seven EU SDS Key Challenges, an additional (eighth) category was introduced ("additional SD objectives") containing a number of objectives that are not included in the EU SDS, but are stated in national SD strategies (NSDS), such as 'sustainable regional development', 'sustainable tourism', 'SD governance' or 'public security & protection'. By including these additional objectives, the monitoring system allows to not only monitor the contribution of FP7 to the EU SDS, but also to the most common objectives stated in national SD strategies.

one of its main features – includes an interactive database which allows analysing the data of the monitoring system from various points of view. To this end, it offers three so-called "Views" producing graphs, maps and tables which can be manipulated by applying several filter options in order to focus the analysis on particular FP7 themes, Work Programmes and EU SDS objectives. The analyses presented in the subsequent section of this quarterly report have been produced by combining the available "Views" and filter options.

In addition to the topics included in the FP7 Work Programmes, information of projects which are or have actually been carried out within FP7 has been integrated into the interactive database in order to allow even more sophisticated analyses, such as analysing the amount of funding ("EC contribution") dedicated to research on "climate change", "low carbon economy", "SD governance", etc., only to name a few. Moreover, the analyses can be broken down to the national and regional levels, allowing for a comparison across EU Member States or between regions within a particular country.

The monitoring system currently (as of July 2010) comprises information on about 2,000 topics (from the 'Cooperation' Work Programmes 2007 to 2010) and 2,500 projects (from the years 2007 to 2009) with more than 27,000 project partners and a total EC contribution of more than € 8,500 million.

In order to stimulate a public debate, the database allows 'zooming' into the detailed screening results, i.e. the impacts a topic is expected to have on the key challenges and operational objectives of the EU SDS (see above), and additionally enables users to provide feedback.

For a more detailed description of the monitoring system's interactive database, please consult the guideline at www.fp7-4-sd.eu.

2.3 How does the FP7 contribute to the renewed EU SDS? An analysis of the 'Cooperation' Work Programmes 2007-2010

This section summarises some main results of how FP7-funded research contributes to the key challenges and objectives laid down in the renewed EU SDS. It focuses on the **ten themes of the Specific Programme 'Cooperation'** (see above) and comprises analyses created by using the "Views" and filter options available at www.fp7-4-sd.eu. First, the overall contribution to the seven EU SDS key challenges in terms of on both number of projects and the amount of funding provided by FP7 will be illustrated. Then, the key challenges will be presented in more detail, by focusing on how individual operational objectives (such as 'reducing greenhouse gas emissions', 'halting the loss of biodiversity', 'improving mental health' or 'promoting increased employment of young people') are addressed by FP7 projects.

Please note that the results presented in this section refer to data extracted in June 2010. Due to regular updates of the monitoring system, e.g. in case new projects from recent Work Programmes are added to the database, the figures presented on www.fp7-4-sd.eu may already refer to a more recent dataset and can therefore differ from those presented here.

2.3.1 *Overview of FP7 contribution to EU SDS key challenges*

Overall, about **75 % of the projects** that have been funded within FP7 so far (from the Work Programmes 2007 to 2009) contribute to one or more of the EU SDS key challenges (projects from the most recent Work Programme 2010 are not yet included as they are still under negotiation). The number varies between 74 % and 77 %, respectively, depending on whether the analysis is based on (a) the number of projects or (b) the amount of funding provided by FP7 (“total EC contribution”).

On the level of EU SDS key challenges, Figure 3 shows that the key challenges “**public health**”, “**climate change and clean energy**” and “**conservation and management of natural resources**” are addressed most prominently by FP7 projects, with “public health” on top, having more than 650 projects contributing to strategy’s objectives related to health issues. The key challenges “climate change and clean energy” and “conservation and management of natural resources” are addressed by about 480 and 400 projects, respectively. On the other end of the scale, the key challenges “social inclusion, demography and migration” and “global poverty and sustainable development challenges” are only addressed by some 150 projects each.

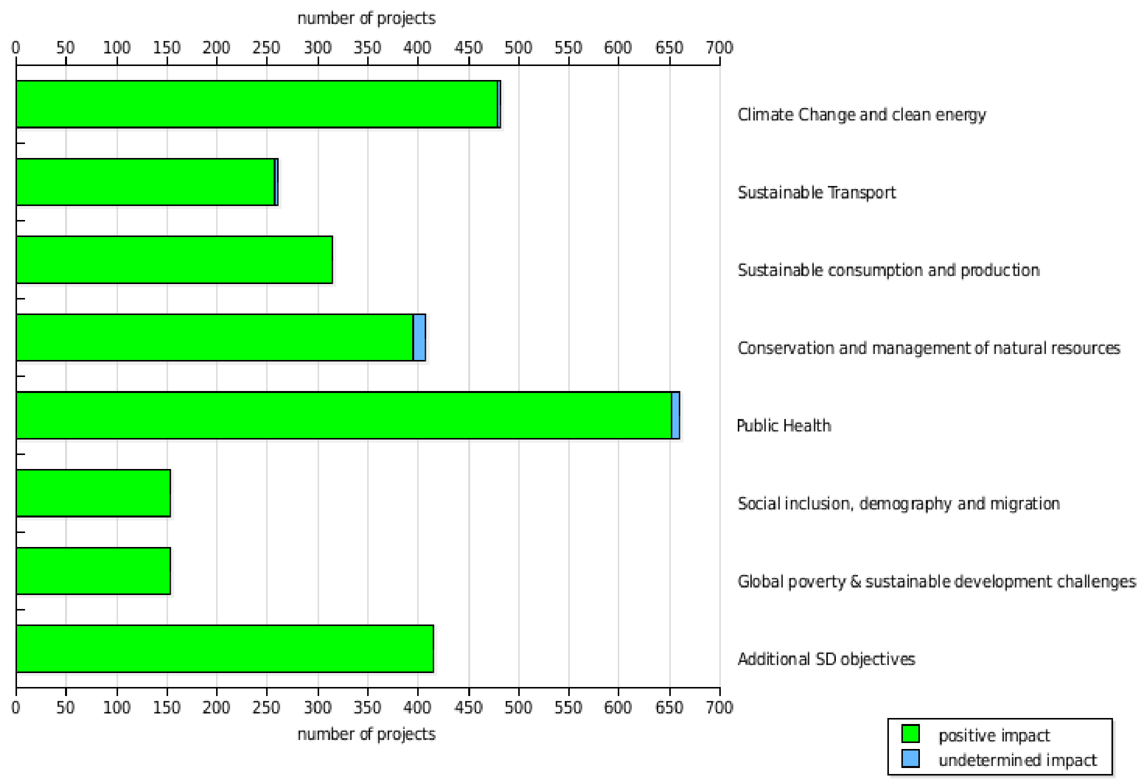


Figure 3: number of projects contributing to the EU SDS key challenges [15]

Figure 3 also shows an eighth category called “Additional SD objectives”; this “key challenge” has been added in order to cover objectives included in national SD strategies (NSDSs) which

[15] Since each project may have impacts on more than one operational objective and/or key challenge, the sub-totals (number of projects and amount of funding per key challenge) should not be added up as this would result in potentially overestimated figures!

are not considered in the EU SDS, such as 'sustainable regional development', 'sustainable tourism', 'SD governance' or 'public security & protection'. Notably, these additional objectives are addressed by some 400 projects, indicating a relatively high relevance for European SD research.

When interpreting the figures presented above, it has to be kept in mind that the number of impacts on the different EU SDS key challenges is partly predetermined by the structure of the FP7 ‘Cooperation’ programme. The FP7 theme HEALTH, contributing excessively to the EU SDS key challenge “public health”, has one of the largest budgets of the ‘Cooperation’ programme, thus explaining the prominence of projects contributing to the EU SDS’ health objectives.

In addition, it is important to note that not all topics called for in the annual Work Programmes have been translated into action by selecting projects for being funded. While the FP7 theme TRANSPORT comprises the highest number of topics, the number of projects having an impact on the EU SDS key challenge “sustainable transport” is on the lower end of the scale (see Figure 3).

In terms of funding provided to the research projects carried out under FP7’s ‘Cooperation’ programme, Figure 4 shows a similar picture as presented above. Projects contributing to the key challenge “public health” receive a funding of more than € 2,600 million, followed by projects contributing to the key challenge “climate change and energy” with a total EC contribution of more than € 2,000 million. Again, projects contributing to the key challenges “social inclusion, demography and migration” and “global poverty and sustainable development challenges” range at the lower end of the scale, with a total EC contribution of about € 400 million and € 550 million, respectively.

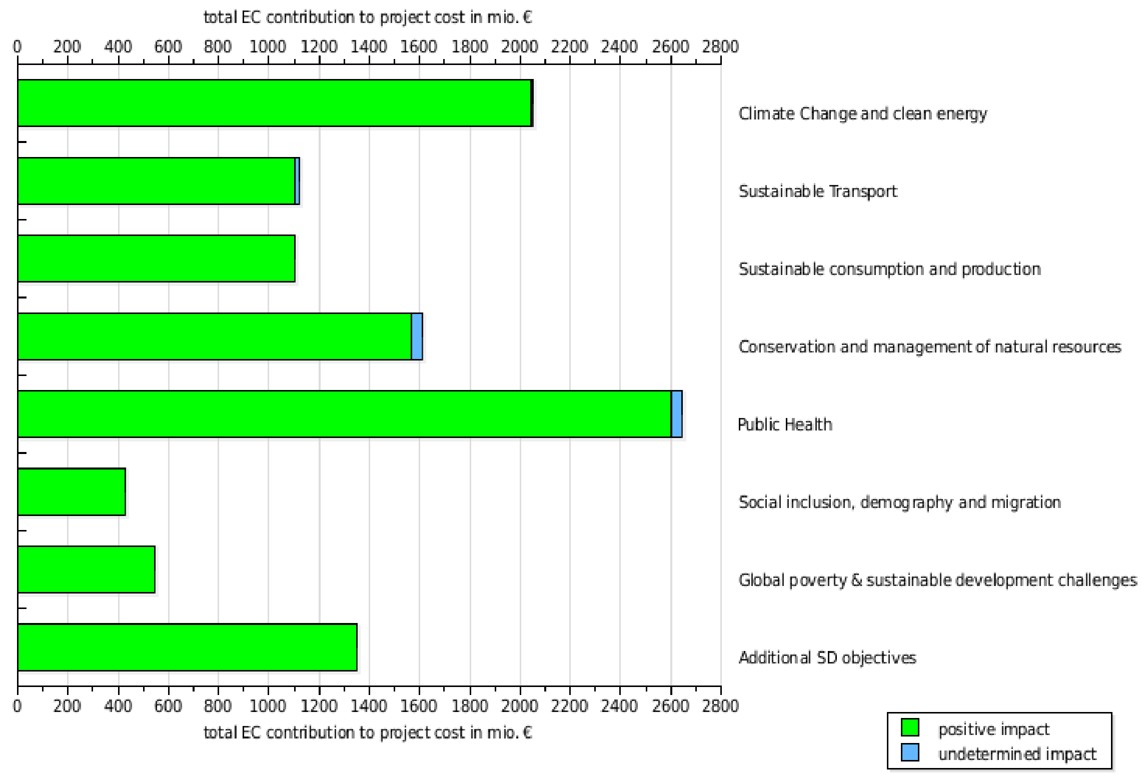


Figure 4: total EC contribution to projects contributing to the EU SDS key challenges (€ million) [16]

Notably, while the key challenge "conservation and management of natural resources" and the "additional SD objectives" were both addressed by about 400 projects (see Figure 3), the amount of funding provided to the respective projects differs significantly: while projects contributing to key challenge "conservation and management of natural resources" receive a funding of about € 1,600 million, the EC contribution to projects contributing to the "additional SD objectives" is about € 250 million less. This indicates that, on average, projects contributing to key challenge "conservation and management of natural resources" are of larger scale, i.e. they receive more funding per project than those contributing to the "additional SD objectives". A similar tendency is observable for projects contributing to the key challenges "sustainable transport" and "sustainable consumption and production" (see Figure 3 and Figure 4), with "sustainable transport" being addressed by fewer, but larger-scale projects.

2.3.2 In-depth analysis of key challenges and operational objectives

In the following, the analysis of impacts of FP7 research on the EU SDS key challenges is being broken down to the level of operational objectives. This section therefore focuses on identifying the respective operational objectives comprising the largest share of projects and respective EC contribution.

It is important to note that for each of the seven EU SDS key challenges an additional category ("other expected impacts on this key challenge") has been introduced in order to

[16] Since each project may have impacts on more than one operational objective and/or key challenge, the sub-totals (number of projects and amount of funding per key challenge) should not be added up as this would result in potentially overestimated figures!

account for impacts that are clearly related to a particular key challenge, but not covered by the respective operational objectives, such as issues related to ‘understanding of climate change’, ‘transport safety’, ‘healthcare’, ‘food safety & security’, etc.). For some EU SDS key challenges such as “public health” and “social inclusion, demography and migration”, this additional “objective” comprises an important part of impacts contributing to the key challenge.

2.3.2.1 Climate change and clean energy

Within the key challenge “climate change and clean energy”, the operational objective “reducing energy consumption” is addressed most prominently, and with a total of more than 200 projects by far outstrips the other objectives. “Reducing greenhouse gas emission” is another important objective, with about 120 projects contributing to it. The operational objective “raising the share of biofuels” ranges at the lower end of the scale, with less than 50 projects. This picture is also reflected when looking at the distribution of funding (total EC contribution): more than € 970 million are spent on projects contributing to “reducing energy consumption”, followed by “reducing greenhouse gas emissions” with a total EC contribution of some € 580 million. The objective “raising the share of biofuels” accounts for projects receiving a funding of some € 190 million only.

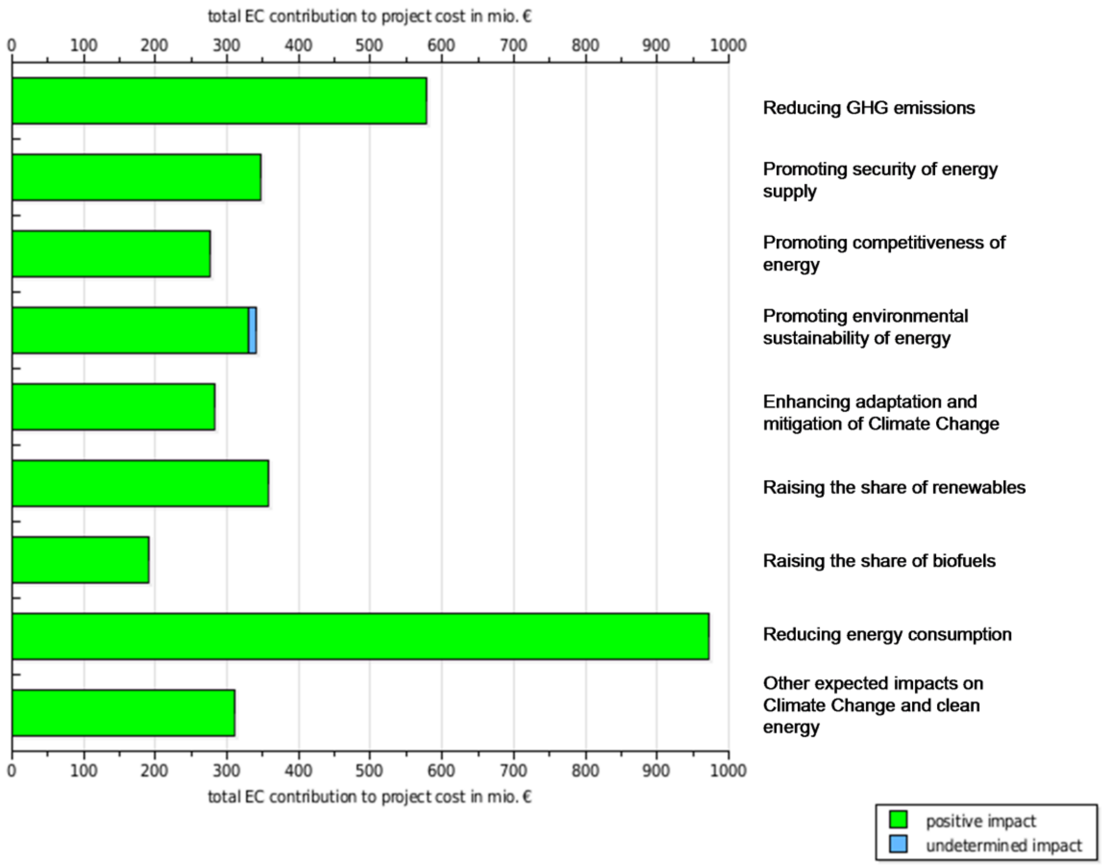


Figure 5: total EC contribution to projects contributing to EU SDS key challenge "climate change and energy" (€ million)

2.3.2.2 Sustainable transport

The operational objectives “reducing transport greenhouse gas emissions” (about 130 projects) and “achieving sustainable levels of transport energy use” (about 120 projects) account for the largest number of projects contributing to the key challenge “sustainable transport”. In contrast, the objectives “modernising the EU framework for public passenger transport”, “decoupling economic growth and demand for transport” and “reducing CO2 emissions from new car fleets” are only addressed by a handful of projects. Looking at project funding (total EC contribution) reveals similar patterns of distribution, with projects contributing to “reducing transport greenhouse gas emissions” and “achieving sustainable levels of transport energy use” receiving funding of almost € 600 million, respectively.

2.3.2.3 Sustainable consumption and production

The number of projects with expected impacts on the operational objectives of “sustainable production and consumption” ranges from about 130 projects related to “encouraging the uptake of environmentally/socially better performing products and processes by businesses and consumers” to only 2 projects addressing the objective of “raising the level of Green Public Procurement (GPP)”. Some 70 projects address the objective of “improving the environmental performance of products and processes”. Looking at the total EC contribution to projects reveals a similar picture, with projects addressing the objective “encouraging the uptake of environmentally/socially better performing products and processes by businesses and consumers” receiving a total EC contribution of almost € 500 million.

2.3.2.4 Conservation and management of natural resources

The operational objectives “improving management and avoiding overexploitation of renewable natural resources” (about 140 projects) and “promotion of eco-efficient innovations” (about 100 projects) account for the largest share of projects addressing this key challenge. In contrast, the objectives “contributing effectively to achieving the four United Nations global objectives on forests” and “halting the loss of biodiversity” account for the lowest number of expected impacts with 12 and 22 projects, respectively. Notably, project funding (total EC contribution) shows a more smooth distribution, with the objectives “improving management and avoiding overexploitation of renewable natural resources”, “promotion of eco-efficient innovations”, “improving resource efficiency” and “avoid generation of waste by applying the concept of life-cycle thinking” being addressed by projects receiving a total EC contribution between € 360 million and € 450 million. Again, the objectives “halting the loss of biodiversity” and “contributing effectively to achieving the four United Nations global objectives on forests” range at the lower end of the scale, accounting for a total EC contribution of less than € 100 million and € 50 million, respectively.

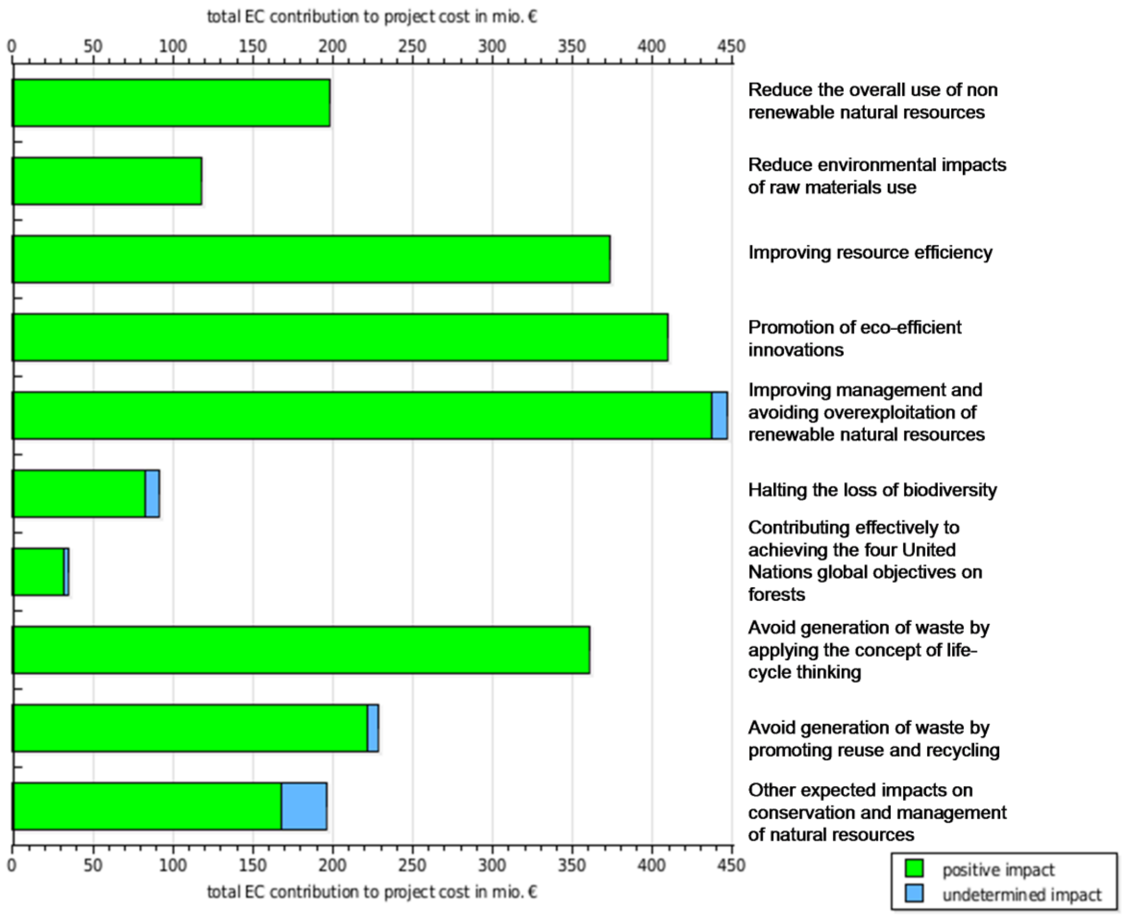


Figure 6: total EC contribution to projects contributing to EU SDS key challenge "conservation and management of natural resources" (€ million)

2.3.2.5 Public health

Analysing the EU SDS key challenge “public health” on the level of operational objectives shows a rather interesting picture: in contrast to the other key challenges, most projects contribute to the “other expected impacts on public health” category that was added in order to account for impacts that are clearly related to a particular key challenge, but are not covered by the respective operational objectives. For the “public health” key challenge, this category summarises impacts related to ‘healthcare’, ‘occupational health’, ‘disease control’, ‘food safety & security’, etc., which are addressed by about 300 projects with a total EC contribution of more than € 1,200 million(!). Thus, this category does not only by far outstrip the other operational objectives within “public health”, but also those from the remaining six key challenges.

Out of the remaining “real” operational objectives within “public health”, the objectives “curbing the increase in chronic diseases” and “developing capacities to respond to health threats in a coordinated manner” are addressed most prominently, being addressed by projects receiving a total EC contribution of more than € 900 million and € 600 million, respectively. On the other end of the scale, the objectives “tackling suicide risks” (2 projects), “improving food and feed legislation (incl. labelling)” (6 projects) and “ensure that chemicals, including pesticides, are produced, handled and used in ways that do not pose significant threats to human health and the environment” (10 projects) are addressed least prominently.

2.3.2.6 Social inclusion, demography and migration

Within the key challenge "social inclusion, demography and migration", the objective "reducing the number of people at risk of social exclusion" and the category "other expected impacts on social inclusion, demography and migration" (referring to a variety of issues related to social inclusion, including social policy) account for the largest number of projects with expected impacts, with slightly above and below 50 projects, respectively. Notably, the objectives "reducing the number of people at risk of poverty", "reducing child poverty" and "reduce negative effects of globalisation on workers and their families" are not being addressed at all by FP7 research projects. The distribution of project funding across objectives depicts a similar picture, with the objective "reducing the number of people at risk of social exclusion" and the category "other expected impacts on social inclusion, demography and migration" accounting for projects receiving a total EC contribution of about € 170 million and € 110 million, respectively.

2.3.2.7 Global poverty and sustainable development challenges

The key challenge "global poverty and sustainable development challenges" is characterised by a dominance of projects addressing the objective "contributing to achieve the Millennium Development Goals". With some 110 projects accounting for a total EC contribution of about € 460 million, it by far outstrips the other objectives within the key challenge. Notably, the objective "raising the volume of Official Development Assistance (ODA)" is not addressed at all by FP7 research projects, and the objectives "promoting SD in the context of WTO negotiations", "increasing the coherence of aid policies" and "including SD concerns in all EU external policies" are addressed by a handful of projects only.

2.3.2.8 Additional SD objectives

Out of the additional SD objectives that complement the EU SDS objectives in order to account for additional issues included in national SD strategies (NSDSs) only, the two objectives "protection against natural disasters" and "maintaining public security and protection" are addressed most prominently, with some 130 and 140 projects, respectively. In terms of project funding, the two objective accounts for more than € 460 million and € 410 million, respectively. "Promoting and strengthening SD governance" represents another important objective, being addressed by about 70 projects with a total EC contribution of more than € 270 million. On the other end of the scale, "promoting sustainable tourism" is addressed by 5 projects only, accounting for a total EC contribution of some € 10 million.

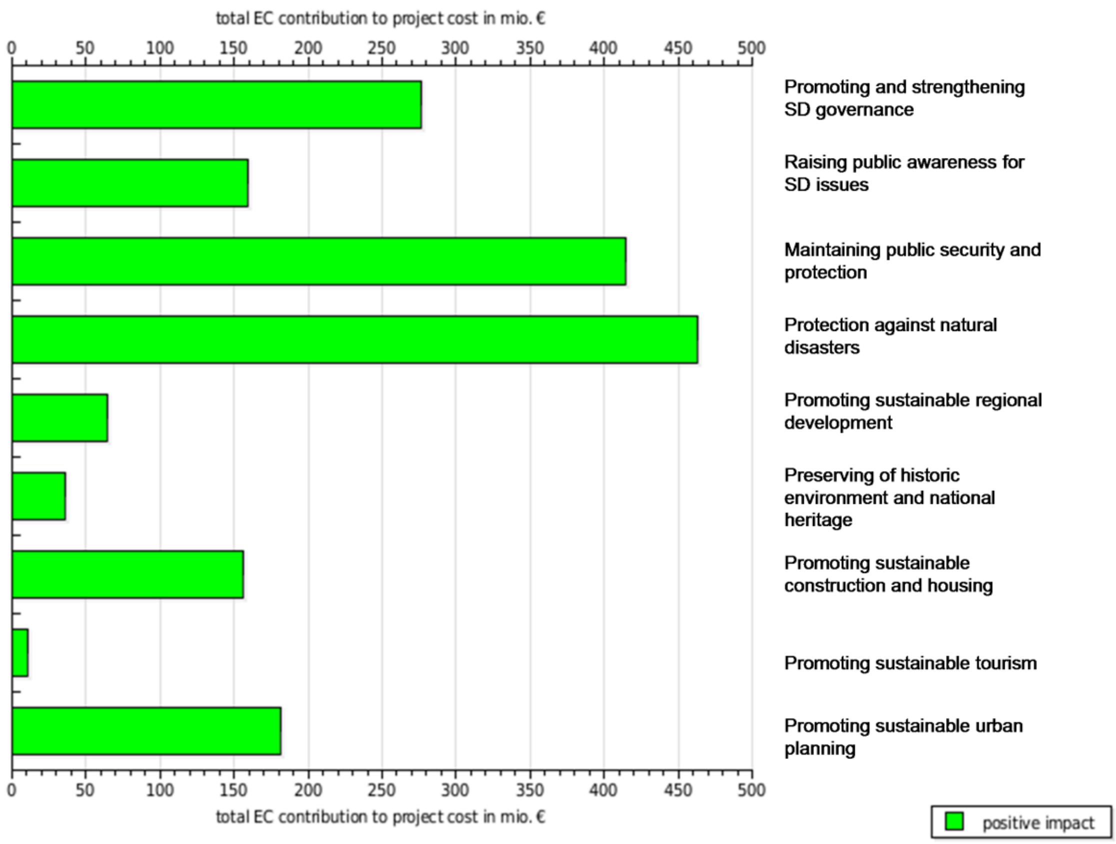


Figure 7: total EC contribution to projects contributing to "additional SD objectives" (€ million)

2.3.2.9 Concluding remarks on the analysis of operational objectives

When comparing the structure of the operational objectives within the various EU SDS key challenges, it becomes obvious that for some key challenges the contribution of FP7 research projects is focused on one or two specific objectives. This is mainly the case for the key challenges "climate change and clean energy" (objective "reducing energy consumption"), "public health" (category "other expected impacts on public health"), "global poverty and sustainable development challenges" (objective "contributing to achieve the Millennium Development Goals") and the "additional SD objectives" (objectives "protection against natural disasters" and "maintaining public security and protection").

In contrast, the key challenges "sustainable transport", "sustainable consumption and production", "conservation and management of natural resources" and "social inclusion, demography and migration" show a more smooth distribution of expected impacts across the respective operational objectives.

Comparing the funding allocated to projects across the EU SDS key challenges (including the "additional SD objectives") reveals the following picture (see Figure 8): projects contributing to the "other expected impacts on public health" receive a total EC contribution of more than € 1,250 million, followed by the objectives "reducing energy consumption" and "curbing the increase in chronic diseases", accounting for a project funding of € 970 million and € 900 million, respectively.

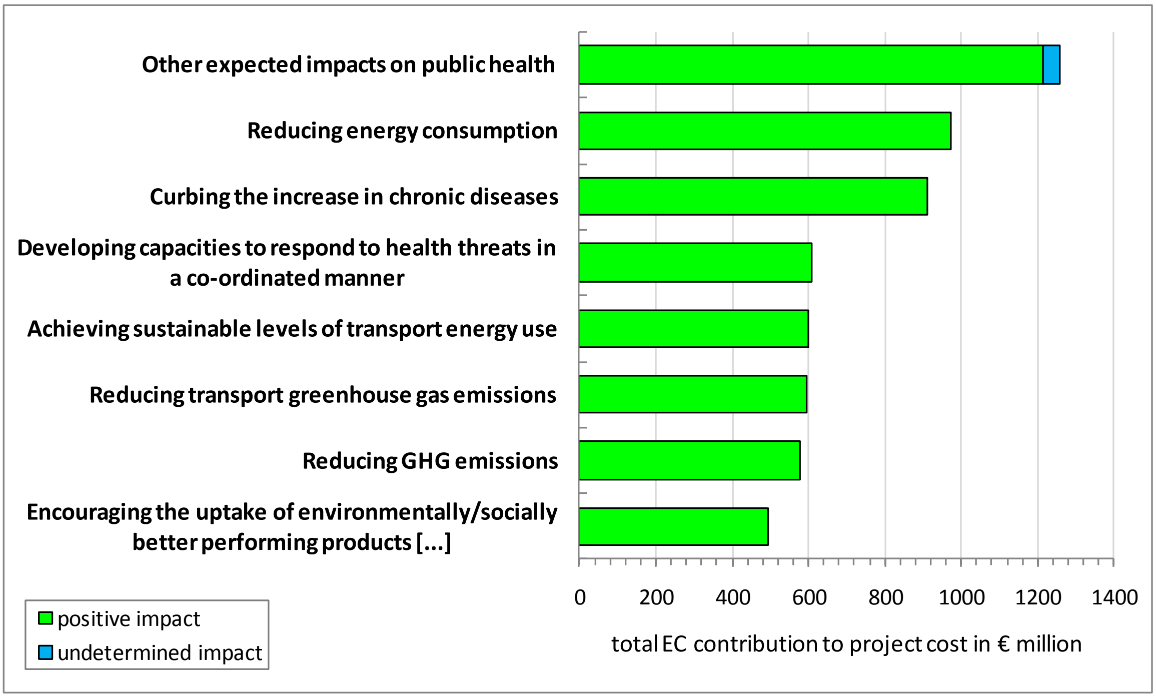


Figure 8: total EC contribution to projects contributing to EU SDS objectives (€ million)

As Figure 8 shows, 3 out of the top 4 objectives (in terms of project funding) relate to the key challenge “public health”. This goes conform to the findings presented further above, i.e. that the EU SDS key challenge “public health” is addressed most prominently by research conducted in FP7. Other important objectives, indicated by the EC contribution related to them, are “reducing energy consumption” and “reducing greenhouse gas emissions” (from the key challenge “climate change and clean energy”), and “achieving sustainable levels of transport energy use” and “reducing transport greenhouse gas emissions” (from the key challenge “sustainable transport”).

2.3.3 Investigating the “centres of excellence” of research for SD across Europe

While the previous sections analysed the FP7 contribution to the EU SDS key challenges based on all projects funded so far within FP7, this section investigates differences between EU Member States by breaking down the data of the monitoring system to the national level. It thereby draws on the so-called “Geographical View” of the interactive database on www.fp7-4-sd.eu and analyses the number of project coordinators with respect to the EU SDS key challenges. Differences in the number of project coordinators between Member States are interesting because in order to successfully coordinate a project, the respective institutions are usually characterized by an exceptional scientific knowledge base and the essential coordination skills to implement the respective project, thus providing information on the “centres of excellence” as regards research for sustainable development within the EU.

When interpreting the figures presented in this section, it has to be acknowledged that the size of population in the Member States is in most instances highly correlated with the number of researchers and research infrastructures. Consequently, the large countries Germany, United Kingdom, Italy and France are usually on the top, i.e. having the highest number of project coordinators across Europe. The analyses presented here therefore also aim at investigating centres of excellence in smaller countries, i.e. those having a high number of coordinators with respect to population size.

Figure 9 shows the number of projects coordinators of FP7 research projects contributing to the EU SDS key challenges in EU Member States and countries associated to FP7. With more than 300 coordinators, Germany is on the top, followed by the UK (about 260 coordinators), Italy (about 210 coordinators) and France (about 190 coordinators). Together, project participants from **these four countries coordinate more than 50 % (!) of all FP7 research projects contributing to SD**.

The Netherlands and Belgium constitute additional centres of excellence as regards SD related research, with some 140 and 110 project coordinators, respectively.

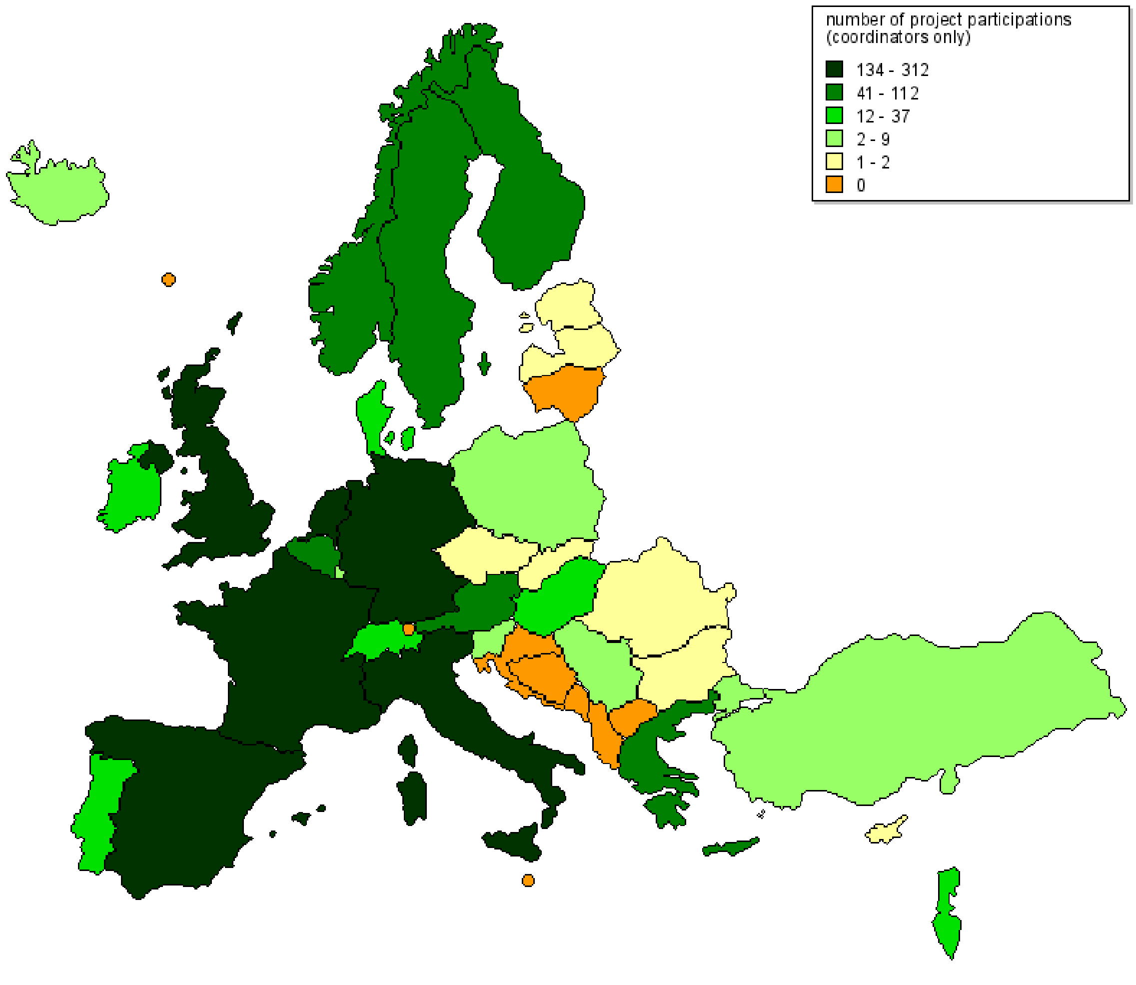


Figure 9: number of project coordinators of projects contributing to sustainable development

2.3.3.1 Climate change and clean energy

Germany accounts for the by far largest number of coordinators of projects contributing to the key challenge “climate change and clean energy”. With some 90 project coordinators, about 20 % of all projects related to this key challenge are coordinated by German project participants. Besides Germany the EU Member States Italy, the UK and France constitute other important centres of excellence, with about 50 project coordinators each.

2.3.3.2 Sustainable transport

Within the key challenge “sustainable transport” France and Germany represent important centres of excellence, with about 40 project coordinators each, thus together coordinating about one third of all FP7 projects with impacts on this area. Relatively high numbers of project coordinators also come from Italy, the United Kingdom and – notably – Belgium, with about 30 project coordinators each.

2.3.3.3 Sustainable consumption and production

The largest numbers of coordinators of projects contributing to the key challenge “sustainable consumption and production” come from Germany (some 55), the UK and Italy (about 40 each). Notably, Belgium and the Netherlands are on a level with France, with about 20 project coordinators each, only exceeded by Spain with some 35 coordinators. Again, participants from the four biggest countries (in terms of number of project coordinators; these are: Germany, UK, Italy, Spain) coordinate more than 50 % of all FP7 projects with impacts on this key challenge.

2.3.3.4 Conservation and management of natural resources

Similar to the observation with respect to the key challenge “climate change and clean energy” above, Germany again accounts for the by far largest number of coordinators of projects contributing to the key challenge “conservation and management of natural resources”. With some 75 project coordinators, the share of projects contributing to this key challenge and being coordinated by German participants ranges slightly below 20 %. The UK and France – again – constitute other important centres of excellence, with some 45 project coordinators each. Notably, except for Hungary and Poland, there are no project coordinators from Eastern European countries with respect to this key challenge.

2.3.3.5 Public health

The countries with the highest numbers of project coordinators within the key challenge “public health” are Germany and the United Kingdom, with some 120 and 100 coordinators, respectively. Project participants from these two countries together coordinate about one third of all projects contributing to this key challenge. Other important centres of excellence are Italy, the Netherlands and France, with about 65 project coordinators each. Adding up the five countries comprising the largest number of project coordinators reveals that almost two thirds of projects contributing to “public health” are coordinated by project participants from Germany, the UK, Italy, the Netherlands and France.

2.3.3.6 Social inclusion, demography and migration

Analysing the number of project coordinators with respect to “social inclusion, demography and migration” shows a rather smooth picture, i.e. the differences between the EU Member States are significantly smaller as compared to the other key challenges. Nevertheless, Germany accounts for the largest number of project coordinators (some 25), followed by the UK, Italy and the Netherlands with about 15 project coordinators each. Similar to the picture presented in the key challenge “conservation and management of natural resources” above, there are rarely no project coordinators from Eastern European countries with regard to “social inclusion, demography and migration”.

2.3.3.7 Global poverty and sustainable development challenges

Projects contributing to the key challenge "global poverty and sustainable development challenges" are mainly coordinated by participants coming from the UK (some 35 coordinators) and France (some 25 coordinators). Germany, being the most prominent centre of excellence for a number of other key challenges, ranks third, being level with Belgium, the Netherlands and Spain (about 15 coordinators each). Again, the number of project coordinators from Eastern European countries is remarkably low.

2.3.3.8 Additional SD objectives

With respect to the "additional SD objectives" that complement the EU SDS objectives in order to account for additional issues included in national SD strategies (NSDSs) only, Germany, the UK and Italy hold the largest share of project coordinators (some 60 coordinators each). Together, participants from these three countries coordinate more than 40 % of the projects impacting on the objectives listed hereunder.

Focusing the analysis on the objective of "promoting and strengthening SD governance" shows the UK in front, followed by Italy, France, the Netherlands and Germany. Due to the overall small number of projects contributing to SD governance, differences between the five "leading" countries (with about 10 project coordinators each) and the rest of Europe are, however, rather small (see Figure 10).

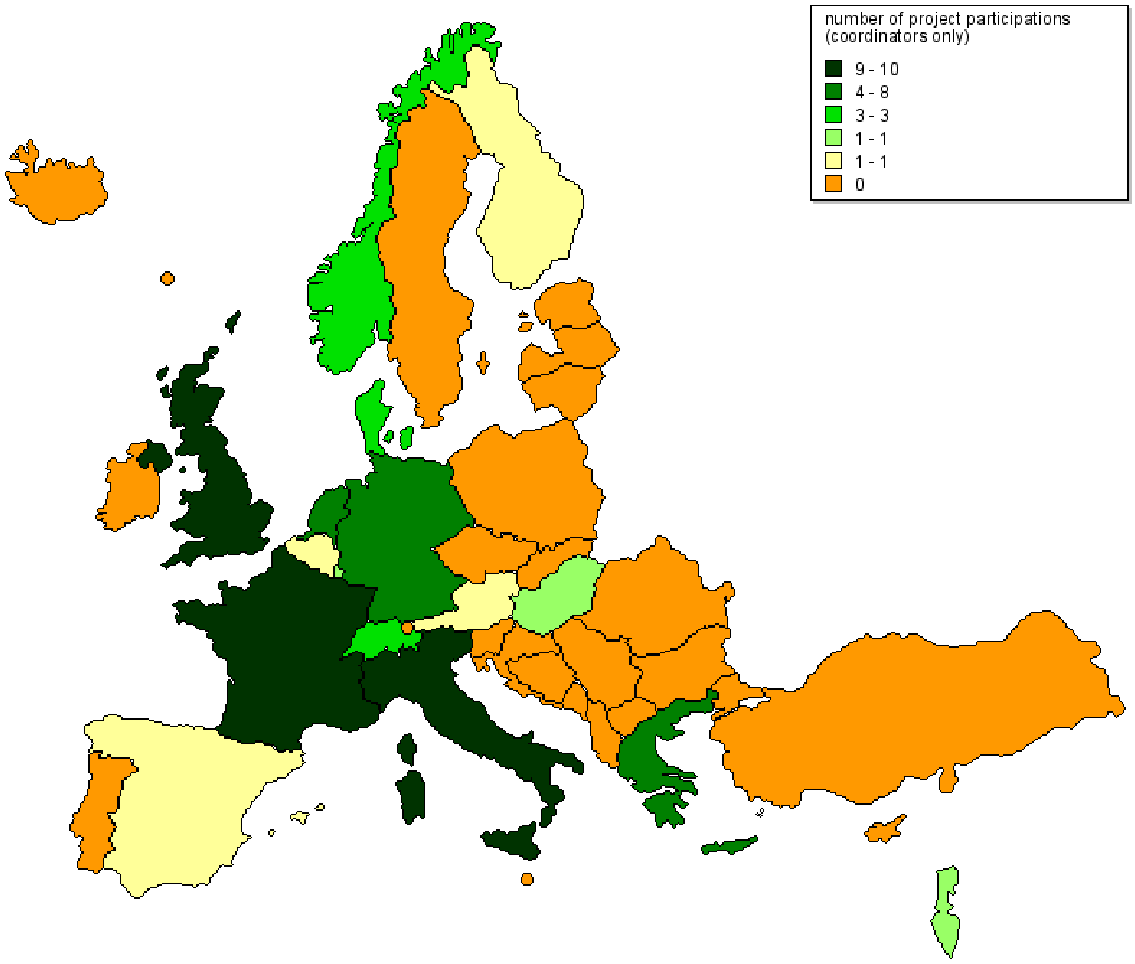


Figure 10: number of project coordinators of projects contributing to the objective "improving and strengthening SD governance"

2.3.3.9 Low-carbon research

By combining the available “views” and filter options of www.fp7-4-sd.eu, it is not only possible to focus the analysis on particular FP7 themes or EU SDS key challenges, but to analyse the database with regard to issues not directly taken into account for the scientific evidence-based screening (although these issues need to be able to be “recreated” by using the filter options). An example of such an issue is “low-carbon” research, i.e. research contributing to the aim of reaching a “low-carbon economy”, as outlined in the Commission communications on “An Energy Policy for Europe” (European Commission, 2007b) and on the new “Europe 2020” strategy (European Commission, 2010b).

Similar to the picture drawn from analysing the EU SDS key challenges, the largest amount of projects contributing dealing with “low-carbon” research are coordinated by German participants (some 160 coordinators), followed by participants from the UK (115 coordinators), Italy (100 coordinators) and France (90 coordinators). Spain, the Netherlands and Belgium, ranging between 60 and 70 project coordinators, constitute additional prominent centres of excellence.

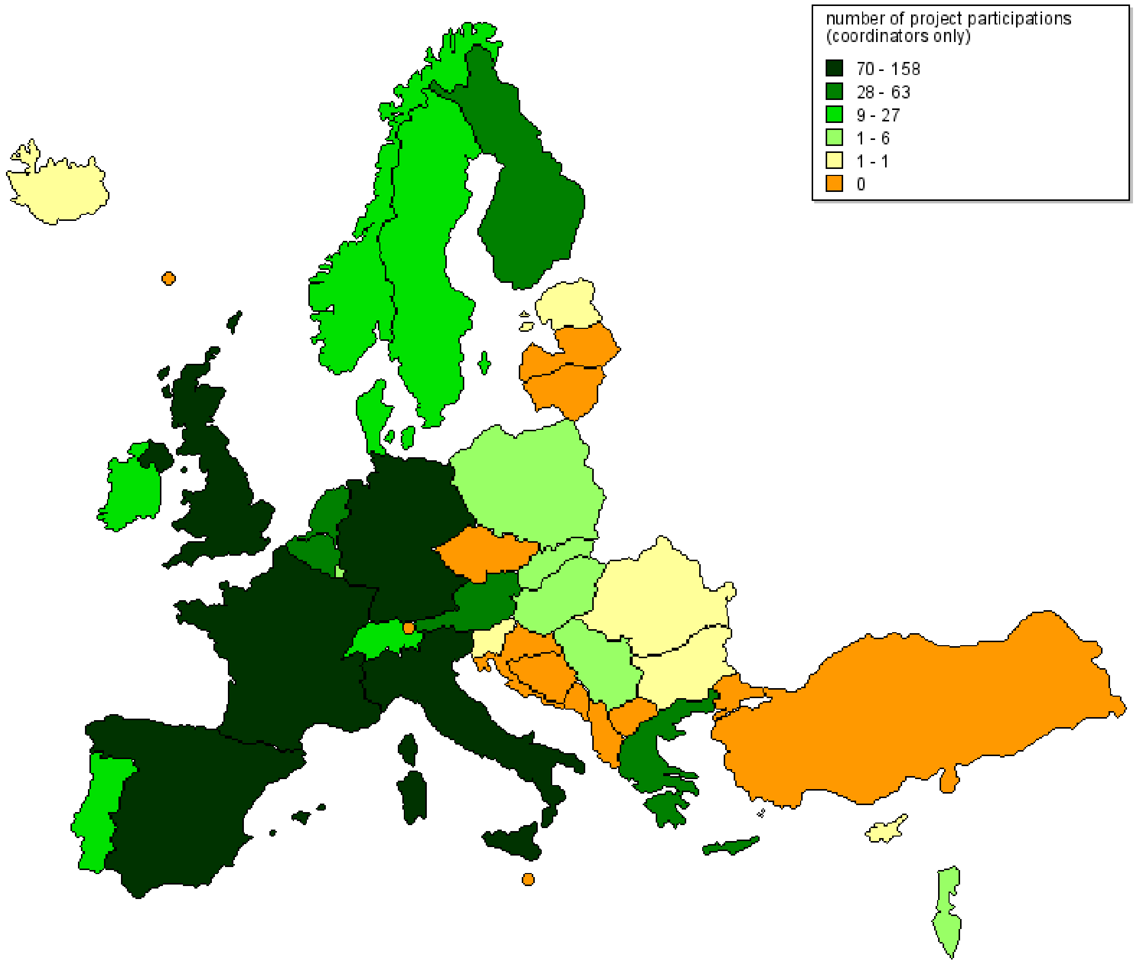


Figure 11: number of project coordinators of projects contributing to "low-carbon" research

2.3.3.10 Concluding remarks on the analysis of European centres of excellence

As already mentioned above, analysing the European research landscape with regard to impacts on the EU SDS key challenges shows large countries, in particular Germany, the United Kingdom, Italy and France, usually on the top, i.e. a large share of projects contributing to EU SDS key challenges and objectives are coming from these four countries. Analysing the EU SDS key challenges overall, project participants from these four countries coordinate more than 50 % of all FP7 research projects contributing to SD.

This picture, however, changes when focusing the analysis in specific key challenges. With regard to the key challenges “climate change and clean energy” and “conservation and management of natural resources”, Germany constitutes a prominent centre of excellence, with German participants coordinating about 20 % of all FP7 research projects related to these areas. The key challenges “sustainable transport” and “global poverty and sustainable development challenges” are the only two for which other European countries (France and the UK) outstrip Germany in terms of number of project coordinators. Besides the above mentioned four “leading” countries, the Netherlands and Spain constitute additional centres of excellence, in particular as regards “public health”, “sustainable consumption and production” and “social inclusion, demography and migration”. Notably, the number of project coordinators from Eastern European countries is generally low, in particular with respect to the key challenges “conservation and management of natural resources”, “social inclusion, demography and migration” and “global poverty and sustainable development challenges”.

3 National Sustainable Development Strategies and Research and Development for Sustainable development

This section provides a general overview of the research and development (R&D) targets set out in the National Sustainable Development Strategies (NSDS) of the 27 EU Member States. The aim of this section is to:

(1) detect which topics, sectors, cross-cutting issues of sustainable development are promoted in the national research agendas within the NSDS:
(2) identify at which level the research strengthening efforts (as a strategic goal, or as an action measure) are targeted;
(3) provide a short overview of and describe the concrete R&D targets and actions in various strategic directions and key sectors of sustainable development.

This information is summarized in Table 1. The data was gathered through screening the NSDS documents for the following key words: “RESEARCH”, “R&D”, “RTD” (Research and technological development). The overview includes information on 23 strategies; the NSDS of Luxembourg and France are only available in French; Bulgaria could not be screened on keywords, due to its special format conditions; and Poland still has no NSDS.

Table 1: Tabular overview of R&D for sustainable development in the NSDS

Austria

R&D in NSDS	Research has been targted in some key objectives on all four action fields in the strategy:1) quality of life in Austria; 2) Austria as a dynamic business location; 3) Living spaces in Austria; 4) Austrias responsibility. In all these fields, the aim has been to orient more innovations towards the model of SD. This should be done in all sectors (public and private sector) and further strengthened through research networking for SD.			
Area	Quality of life	Business location	Living spaces	Austrias Responsibility
Objective/sectors/topics	Education and research	Innovative structures promote competitiveness	1) Protection of environmental media and climate; 2)Preserving the diversity of Species and Landscapes 3) Optimising the transposrt system	International cooperation and Financing
Targets/Actions	To expand further the national research programmes for SD and cooperation between research and education for a SD. As education requires knowledge and thus research for a SD, and new innovations, a research-political target system and research-political instruments are aimed to be further developed.	To promote need-oriented research and increase R&D funding, in innovation structures towards the model of SD. The concrete objectives are to catch up with the research quota(2.5% of GDP) by 2005, and to establish the core issues of SD in R&D as: -resource efficiency, -space relevance, -participative approaches. guiding principles of research policy.	To protect the environmental media through the establishment of both basic scientific and problem solving-oriented research and a nationwide system of environ-mental quality targets. 2) To achieve biodiversity protection, focus research programmes must be developed and implemented in cooperation with the relevant users of space. 3) To promote existing research and technology grants focussed particularly on sustainability-relevant objectives in the transport sector.	To consolidate Austria`s position in the EU framework programmes for RTD in the field of sustainability research.

Belgium

R&D in NSDS	R&D has been prioritised in three action fields of the strategy out of 24 action areas.The focus of R&D expanding is mainly on environmental issues of SD in varios topics as in energy efficiency, sustainable agriculture and reorineting research towards the SD model by increasing R&D in various sectors.		
Area	Enterpreneur & agricultural world	Striving for better health worldwide	A sustainable energy policy
Objective/sectors/topics	Foster R&D in agricultural sectors as: 1) environment friendly 2) production, organic agricultture 3) healthy food, 4) natural resources, 5) waste management, 6) mobility.	Networking for new medical technologies	Foster R&D in: 1) renewbale energy sources 2)co-generation fuel cell technology 3)energy efficient technologies
Targets/Actions	To encourage R&D on the above sectors offering growth prospects on SD, in order to move on the high-added value.	To boost R&D partnerships between private and public sectors at national , European and international level for developing cost effectively new medical technologies.	To supoprt R&D in the above mentioned fields and re-orient scientific and technological research towards the target of climate policy.

Cyprus

R&D in NSDS	R&D is being set as a goal in three specific areas out of 10 action fields. The government’s goal is to aid the growth of R&D, shifting the economy towards the development of services with high added value.The areas where R&D should be promoted are the fields of social integration, cross-cutting activities as environmental education and on the economic fields of RTD and innovation.		
Area	Social integration and Demography	Environmenetal Education(EE)	RTD and Innovation
Objective/sectors/topics	To replace low added value with high added value with reinforcement of applied research and growth in the productive process.	To promote research on the various levels of education and sustainable development.	To aid the growth of R&D, shifting the economy towards the development of services with high added value.
Targets/Actions	To support incorporation of R&D in businesses aiming environmental friendly production procedures.	To promote research for Evaluation of implementation meausures as EE or ESD education programmes.	National policy for R&D is implemneted through the Institute for the Promotion of Research (IPR) . The aim is to further promote the IPR programmes under the strategic goal of improvement of competitiveness of the economy under conditions of SD.The IPR national programmes include also projects in the field of SD as : 1) agriculture, 2) fisheries and forestry, 3) natural environment, 4) build environment.

Czech Republic

R&D in NSDS	R&D has been mentioned in two of the five main SD priorities and objectives in the NSDS. The fields inlcude the area of economy and innovation and landscape, ecosystem and biodiversity.	
Area	Economy and innovation	Landscape, eco-systems and biodiversity
Objective/sectors/topics	To foster R&D in following areas: 1)sustainability of the energy sector and materials management 2) human resource developement.	Special measures on R&D are aimed in two out of three priority areas: 1) landscape conservation as a prerequisite for biodiversity conservation; 2) adaption to climate change.
Targets/Actions	The aim is to support R&D and innovation processes in these areas and make the maximum use of science and research in line with EU objectives and obligations, for environmentally sound and knowledge technologies with high added value and lower material or energy consumption.Moreover, the promotion of R&D and innovation is strongly prioritised. The focus is directed especially towards the better linkages between the academic sphere and industry.	The special focus is given to the expansion of R&D in the protection of biotopes, as on how to reduce the impact of climate change on forest and agricultural ecosystems and other relevent areas.

Denmark

R&D in NSDS	The government has established the Environemental Assesment Institute to conduct research at the high international level in the environmental field. R&D has been mentioned in two of the cross-cutting activities(out of 5) and in 4 out of 7 key sectors for SD.	
Area	Sectors	Cross-cutting activities
Objective/sectors/topics	1) agriculture and fisheries (under the heading of “food production”), 2) forestry, 3) industry, trade and services, 4) energy.	1) climate change, 2) biodiversity.
Targets/Actions	The aim in these sectors is to promote further reserach projects and targeted research under the various programmes as the *Danish Research and Development Programme for Food Technology* ; *Nationwide Forest Monitoring Programme* , for the promotion of environmental friendly technologies, renewable energy and sustainble production.	To carry out research on the consequences of climate change as on the topics of preservation and utilisation of nature sustainably in various sectors, in order to build-up the required knowledge in society.

Estonia

R&D in NSDS	R&D is prioritised in one of the main goals of the strategy:"*Growth for Welfare"* and in two cross-cutting action fields: "Education" and "R&D and innovation", out of the four described in the strategy.In the action areas the aim is to support the shift to a more knowledged society.	
Area	Growth for welfare	Cross-cutting action meausures
Objective/sectors/topics		1) Education 2) R&D and Innovation(R&D&I)
Targets/Actions	The target is to move towards an innovation centered economy by strengthening the link between private and public research, as to support the transition from research to the developement of products.	The aim is to develop an educational system which functions as an integral system with the Estonian R&D activity. In the field of R&D&I, the "Knowledge-based Estonia Strategy for R&D 2002-2006" mentioned in the NSDS, aimed to support the orientation of the economy and society towards SD.

Finland

R&D in NSDS	Research has been targeted and envisioned in the objectives of 3 priority areas of the strategy (out of 9): (1) sustainble society,(2) the economy as a safeguard for SD,(3)supporting sustainable choices.The promotion of R&D has been mostly covered in all important fields of SD from the economic and environmental perspective.		
Area	Sustainble society	Economy	Supporting sustainble choices
Objective/Sectors/ Topics	One of the sub-fields "The balance between the use and protection of natural resources" includes efforts for R&D in following objectives: 1) Adapting to the adverse effects of climate change, 2) Ensuring biodiversity, 3) SCP	The economy as a safeguard for SD	On of the sub fields where R&D and education for SD should be aimed is the sub-field of :"Research and development, know-how and innovations".
Targets/ Actions	A research programme on adaptation to climate change will be implemented in 2006–2010, with the target of increasing Finland’s readiness to adapt to climate change.Moreover, the promotion of research in developing business innovations in the area of biodiversity has been emphasised.(3) In the field of SCP,public research will be directed at a new generation of environmental policy that combines various sciences and technologies.	Development of competitiveness requires investment in technology adaptation and R&D of services as well as social innovations. R&D should be further promoted among the various economic sectors, as the main driver to productivity.	The target is to turn innovation and inventions for SD into succesful products on the market and to invest in promising research fields of SD. Moreover, the aim in this area is to achieve sufficient volume and a good level of quality in the research fields of bio and environmental science, the welfare cluster and knowledge-intensive services.

Germany

R&D in NSDS	The government sets as a general objective the promotion of RTD on energy efficiency, environmental research, but as well on information-, biotechnology and raw materials. As one of the main goals of the strategy is to reach a modernisation process for more SD, the strategy aims to increase R&D fundings for consolidationg Germany`s position as a high competitive economy and as an attractive science and research location.Efforts of strengthening research for a SD, are mentioned in various action fields as cross-cutting activities.	
Area	Action fields	Cross- cutting issues
Objective/Sectors/ Topics	1)Energy efficiency; 2)mobility; 3)sustainble production and healthy nutrition.	1) knowledge and education 2) innovation
Targets/ Actions	In all three action fields the target is to support R&D for new technologies and increase fundings for research in the developement of new technologies.	1) The aim is to make Germany an attractive location for education and research through best performing universities in teaching and research. 2) To develop high quality and R&D capacities through a flexible research system, in order to extract more research and enbale more innovation in various key fields of SD. .

Greece

R&D in NSDS	Efforts for strengthening research are mentioned in one out of the 7 actions in the field of "reduction of environmental pressures".
Area	Desertification abatement
Objective/Sectors/ Topics	Reinforcement of research and exchange of information and training is identfied as a priority in this field. The strategy seems not to include explicitly any other targets for focussing research on SD key areas.
Targets/ Actions	

Hungary

R&D in NSDS	The main goal of the strategy towards R&D is to enhance the knowledge base of the society and the process through strengthening scientific research and exchange of knowledge.Therefore, further research is targeted in all three key pillars of SD: in the economic,environmental and social aspects in specific areas mentioned below. Moreover, R&D is not only identified as a priority goal in certain key areas , but as well as a mean for achieving the aim of shifting the society towards a more knowledge based one.			
Area	Tackling unsustainable social processes	Preservation of the environment	Economic developement meting SD requirements	Action measures
Objective/ Sectors/ Topics	1) social cohesion, 2)sustainable communities.	Climate change	1) SCP (material and energy saving production technique); 2) tranformation of energy management(renewable energy, future energy sources (e.g. manufacturing of hydrogen and fuel cells) and replacement of fossil fuels).	1) Placement of R&D in private sectors; 2) transforming institutional system.
Targets/ Actions	To enhance the coordination of research activities, in order to change unsustainble social process by exploring the complex realtionships between health,environment,economy.Moreover, it is aimed to conduct further research on the sustaining of communities.	To promote further research on climate change,(the related factors triggering climate change, regulation and process).	The shift of the economy towards the requirements of SD,implies the research focus to be re-oriented in key areas of SCP and energy management.In the energy field, the aim is to offer means of economic incentives for promoting R&D in areas of renewable energy and replacement of fossil fuels and to stregthen the R&D international coordination.	The target is to place more R&D concerning sustainability on firm foundations and to imporve coordination between private and public sector. For reaching this goal, a research strategy must be elaborated in the future. Regarding the institutional setup, the strategy proposes to create a fora for dialogue and strengthen institutional settings between adminstrative, decision makers and science.

Ireland

R&D in NSDS	The strategy mentions in its action programme 8 key sectors, for shifting the economy towards the purposes of SD. R&D has been set as a goal or a meausre in 5 economic sectors, where there is specifically a need for coordinated R&D policies, inorder to underpin their sustainable development.These sectors include sub-topics, where R&D has to be further strengthened.			
Area	Agriculture	Marine resources	Industry	Transport/ Tourism
Objective/ Sectors/ Topics	1) Waste management and viable nutrient; 2) rural landscapes; 3) afforestration.	To promote marine research measures under the operational porgramme for fisheries.	Environmental research of various key economic sectors.	Environmental research.
Targets/ Actions	The aim is to deeppen further research in these areas and develop research strategies in order to minimise the impact of waste afforestration in the environement of agriculture and enhance the management of set-aside areas.	Under this porgramme the focus will be to deepen research on fish stock dynamics and to orient the research pogramme towards the SD of resources.	Environemental Protection Agency should lead the definition of R&D priorities relating to the environmentally-sustainable use of natural resources, in consultation with the relevant economic sectors, other research institutes.	The Government will commission research to estimate the environmental externalities of road transport and of tourism.

Italy

R&D in NSDS	The strategy concentrates on scientific and technological research for the environment and for the SD.The efforts of R&D can be summarized under two topics.	
Area	Environmental quality	Sustainable use of the natural
Objective/ Sectors/ Topics	To promote research concerning the electromagnetic fields and preventeion of health risks.	To promote scientific research for the the substitution of non-renewables.
Targets/ Actions		

	Latvia	
R&D in NSDS	The strategy displays various goals for R&D in 3strategic areas in order to achieve the recommneded policy results (water, biodiversity,employment) and one cross-cutting activity (education and research) out of 15 action areas displayed in the strategy.	
Area	Economic and environmental aspects	Social aspects
Objective/Sectors/ Topics	1) Water protection; 2) conservation of biodiversity; 3) tourism.	1) Education and science 2) employment
Targets/ Actions	1) To strengthen research on the undergroud watersprings and further use for the supplies at home; 2) to ensure the ecological and biological research regarding the endangered species; 3) to coordinate the reserach and development of different industry sectors (tourism resources, infrastructure, tourism marketing, tourism education and research, tourism statistics etc.).	1) To increase state support for science and research and state aid for the development of innovative companies and infrastructure. To promote the progress of scientific research to commercial research; 2) to provide support for preparation of highly qualified personnel, in order to promote development and implementation of innovations based on the knowledge and research.

	Lithuania	
R&D in NSDS	In the strategy science and knowledge are identified as the engine of the modernisation of the society and economy for a SD.R&D has been prioritised in mostly all action fields of economic and social development mentioned in the strategy. Moreover, the strategy emphasis the need of Lithuania to participate more actively in scientific research programmes and to strengthen the base for scientific research accordingly to the purpose of SD.	
Area	Economic developement	Social developement
Objective/Sectors/ Topics	1) Transport; 2) landscape and Biodiversirty; 3) industry; 4) energy(renewables); 5) agriculture(ecological faming).	2) Public health; 3) education and science.
Targets/ Actions	In mostly all fields the aim is to promote and expand research in energy and natural resources efficiency, in environmnetal technologies and raise fundings for R&D.	The overall aim is to increase the role of scientific research for the social sector and also generally for the purpose of SD.Measures:the estblishment of the courses for SD, enhancemnet of scientific reserach and coordination of developement, especially on pursuing research on ongoing changes and fosee SD trends.

	Malta		
R&D in NSDS	The strategy aims to encourage more reserach in relevant areas of sustainability, as the basis for a knowledged society. Through the National Strategic Plan 2007-2010, Malta undertook a major step in setting a vision and building a framework for national research and innovation. The strategy for SD mentiones efforts to strengthen reserach on relevant sustainability issues in mostly all its strategic directions(in 3 out of 4 areas): (1) managing the environment and resources, (2) promoting sustainbale economic developement; and in (3) Fostering sustianble communities: as education for SD.		
Area	Managing the environment and resources	Promoting sustainbale economic developement	Fostering sustianble communities
Objective/Sectors/ Topics	Out of 10 key areas, R&D should be promoted in : 1) energy saving and renewables 2)biodiversity	Out of 10 key areas R&D is emphasised in following areas: 1) promoting innovation, science and technology 2) sustainable manufacturing 3) tourism	Out of 5 strategic directions, R&D should be pormoted in education for SD.
Targets/ Actions	1) To step up funding for research to improve knowledge on local materials and conditions in building for energy efficiency and in the use of renewables. 2) To promote and fund research to gain a better understanding of local biodiversity, including the establishment and funding of a national inventory/database of biodiversity.	(1) To strengthen the local Science and Technology base. 2)To provide advice and incentives to assist the manufacturing industry in energy conservation, water recycling and active engagement in R&D of innovation in both products and processes. 3)To promote research in natural resource usage for the tourism sector.	To promote research in environmental education to ensure the effectiveness of education for SD programmes.

	Netherlands	
R&D in NSDS	The action porgramme for SD of Netherlands is sub-divided in the national and international part. The Netherlands` government aim is to become a front-runner in higher education, research and innovation. Both parts of the strategy emphasis the goal of strengthening R&D mostly in energy management issues(national level: 1 out of 11 key themes identified and at the international level, 1 out of 5 themes). Moreover, R&D is mentioned in one of the seven cross-cutting tools.	
Area	Energy management	Tools for SD
Objective/Sectors/ Topics	National focus of the strategy: 1)Renewable energy; 2)Energy efficiency. International focus: Coordination with developing countries in the area of energy mangement.	Deployment of research institutes, specialising in SD and adaption of the research more to the needs of the society.
Targets/ Actions	The national part of the strategy focusses on the expansion of the research to topics such as renewable energy and energy efficiency. The international part of the strategy emphasis, strengthening the competence of research centres in developing countries through three regional programmes in sustainable energy.	To elaborate a strategy for the development and commercial explotation of knowledge in Netheralnds.

	Romania	
R&D in NSDS	The general aim of the strategy towards R&D is to connect research to the mainstream scientific and technological development within the EU and to produce essential contributions of Romania research towards the complex objectives of SD. R&D has been mentioned in the strategy in 4 key challenges out of 6 and has been prioritised in one cross-cutting policy areas such as "R&D and Innovation".	
Area	Environemental challenges	Research and development, innovation
Objective/Sectors/ Topics	1) Climate change and energy; 2) sustainable transport; 3) sustainable consumption and production.	The Strategy indicates in this priority area the need for publicly funded research and development activities in the following areas: technologies for the information society, energy, environment, health, agriculture, food security and safety, bio-technology, materials science, innovative products and processes, space and security, socio-economic research and the humanities
Targets/ Actions	1 and 2) The aim is to support R&D in the various fields, by offering fiscal incentives and raising government spending on R&D . 3)R&D will be focussed on those sectors of SCP, where the expected effects are the most significant in terms of ecological progress and competitiveness (organic foodstuffs, water-management technology, energy efficiency, urban transport, industrial processes, construction business, etc)	The overall aim is that the R&D and Innovation sector contribute to the implementation of the principles of SD.It can achieve this by: (1) enhancing institutional capacity, (2) expanding international cooperation in R&D, (3) improving performance and quality of research;(4) involving the private sector in research(1,5% of GDP). Therefore, the National Strategy for R&D and Innovation 2001-2013 has been elaborated.

	Spain		
R&D in NSDS	The strategy distinguishes between three various sustainbility levels: environmental, social and global.Measures to stregthen R&D concetrate in all three areas and in some cross-cutting activities.		
Area	Environmental sustainability	Global sustainability	Social sustainability
Objective/Sectors/ Topics	1) Production and consumption (cross-cutting); 2) climate change.	International cooperation for SD, specifically in the fields related to the United Nations conventions on : 1) climate change 2)desertification and biodiversity 3)to the Global Environment Fund (GEF).	Public health
Targets/ Actions	1) The main goal in this area is the increase of R&D in the field of energy and resource efficiency in production processes of various sectors. Specific attention is given to research on sustainable mobility (clean technologies and clean vehicles). 2)The goal relevant for R&D is to promote research of R&D&I through the R&D&I National Plan, which will incorporate new strategic axis on "Energy" and "Climate Change".	The main R&D priority in this area is to link research centres, mainly in aid receiving countries, to cooperation projects, by stimulating the creation of research networks.The Spanish Cooperation Master Plan 2005-2008 will permit to make progress in the fulfilment of international commitments assumed by Spain.	The main goal is to coordinate research related to public health, especially the relationships between the polluting agents and their repercussions on health.

	Sweden		Slovakia	Slovenia
R&D in NSDS	The strategy identifies the scientifically based knowledge as a decisive factor for SD and as the basis on which to make strategic choices in policy making.It therefore, mentions the effort for expanding research in its strategic challenges of "Encouraging sustainble growth" .Moreover, the strategy identifies R&D in the implementation tools of the strategy. It mentions it in 2 out of 5 tools how to shift the society towards the model of a SD.		The Strategy mentions in one of its strategic goals the need of "Building a modern and quality educational system, support of science and research".	Research for SD is mentioned in 1 of the 5 key development areas of the strategy:"Promotion of knowledge needed for economic development and quality jobs".
Area	Strategic goal	Implementation tools	Building a modern and quality educational system, support of science and research	Technological areas
Objective/Sectors/ Topics	Sustainable growth.	1) sustainable public procurement; 2) education, culture, information and influencing attitudes.	The strategy goal is to build a modern educational system, by supporting science and research.This strategic goal is one of the 26 mentioned in the strategy. It aims to achieve this goal by : 1) carrying out a fundamental reform of the educational system, recovery and rationalism of science and research; 2) closer co-operation of schools and scientific and research institutions; 3) support programmes for creation of new organisational structures of research, development and services in business and non-profit sectors.	electronioc communications and information technologies, biotechnology, pharmacy, nanotechnology, environemental technologies) pharmacy, nanotechnology, environemental technologies.
Targets/ Actions	The government aims to encoruage sustainable growth, by shifting the state support-research toward the priorities of SD. The last two reserach bills as the "Research for Renewal and Research for a "Better Life", "Research and new technology for tomorrow`s energy system" have prioritised SD.	1) Government's objective for public procurement is to stimulate effectively innovation, thereby powering research and technical development and encouraging renewal in the private sector. 2) Education and research in combination with skills training that reflects sustainability concerns is one key to sustainable social development in Sweden.	There is not a specific goal aiming the specific research shift towards SD priorities.However, scientific and research projects oriented to SD issues are being solved at a number of universities and institutes of the Slovak Academy of Science	The focus is on the technological areas linked to economic activities for a higher added value, the applicability of the "two-way flow" of knowledge between research institutions and business and the increasing of funding for R&D to 1% of the GDP.

	United Kingdom			
R&D in NSDS	The strategy emphasis new reseach approaches in various areas of SD. The Government has commissioned research especially in new indicators, in various fields of SCP and environmental protection. Moreover, it has played a key role in promoting research on climate change topics as well as its impact on various sectors and sustainable communities. Each of these areas inlcude also key sectors where further research should be promoted.The government works closely in these fields with the Sustainble Developement Research Network.			
Area	New Strategy	Sustainable Consumption and	Climate change	Natural Resources and environment
Objective/Sectors/ Topics	New indicators for SD	cross- cutting through various sectors	1) inaction of climate change (estimates of social cost of carbon) 2) impact of climate change in various sectors (business,transport,households)	Local inequalities
Targets/ Actions	The UK Government aims to commision reserach on new idicator sets especially in the field of environmental equality and social justice.Sustainable Development Research Network and the Environment and Social Justice Rapid Research and Evidence Review will provide foundation for further work.	Integration of sustainable production with wider business support, through support for R&D and best business practices.	1)Government aims to commission projects in the estimation of the social cost of carbon and its application to policy assessment and aims to support country-led research in CCH for emerging countries. 2)Various research programmes and strategies in these sectors are launched in order to increase funding for research for a better evidence of the impact of these sectors to environemetal pollution (Transport: Powering Future Vehicles (PFV) Strategy, Business: The Carbon Trust, Household: SD Commission.	The govenment will allocate funds for further reserach on the causes of environmental inequality and the effectiveness of meausres to tackle it.

1) More information on the work of SDRN and national reserach programmes on SD, will be provided in the next sub-section.

Source: NSDS strategies, own analysis

3.1 Similarities of R&D measures between EU Member States NSDS

This section provides a summary and a clarification of the results presented in Table 1. Firstly, it shortly outlines the overall spending for R&D and the public and private sector shares of this funding in the various EU Member States. It then categorises the similarities of different NSDS in R&D targets for SD into economic, environmental, social development for SD topics and cross-cutting issues such as education, sustainable consumption and production.

Most countries included in Table 1 share a general aim of fostering R&D as the main driver of increasing innovation and, therefore, competitiveness as well as securing higher attraction for science and research. The efforts in increasing the percentage of R&D in the GDP has been an answer to the EU-wide goal of achieving a 3 % investment in R&D targets as set out in the Lisbon Strategy; this objective has been renewed in the "Europe 2020" strategy. (EurActive, 04.06,2010)

The distinction in the target setting can be categorized in two groups, the "old" (EU-15) and the "new" Member States (EU-11). According to the target system in the NSDS, the old Member States aim to consolidate their position in R&D and RTD programmes in the field of sustainability research (Austria, Netherlands, Finland and Denmark, Sweden) and to reach the target of 3% of GDP invested in R&D. According to Eurostat, Sweden has been the best performer in R&D investment, with 3.6 % of GDP in 2007. No other country surpassed the 3% threshold. Austria was the second-best performer with 2.56%. (EurActive, 04.06,2010). Based on the NSDS, new Member States (EU -1) set a target of 1 to 1.5% of GDP invested in R&D. However, this picture has changed; in preparation of "Europe 2020", the Southeast and Eastern European Countries have adopted a 2.5 % target. The Czech Republic, however, appears to challenge the perception that East European Member States will be unable to reach the 3 % target by 2020. Surprisingly, the government proposed an even higher national target than the more modest 2.3 % proposed by the European Commission. (EurActive, 04.06,2010)

Regarding the division of research funding in public and private research mainly all strategies break down the R&D funds between various sectors –public, private and EU Structural Funds. Countries mostly aim to shift more R&D for sustainability on the private sector while also improving the coordination of research efforts between the private and public sector. Indeed, many countries have re-organised their institutional settings towards a better coordination between public and private research institutions and between administrative decision makers and scientific communities on a more general level. However, no data is available in the strategies on the national targets for R&D funding composition from the private and from the public sector.

The similarities of R&D targets and actions set in various NSDS can be broken down into four domains: strengthening R&D in economic, environmental, social development aspects and cross-cutting SD topics.

3.1.1 Economy and Sustainable Development

In the area of economy and SD, investments in R&D are regarded as the driver for a more competitive economy and a knowledge-based society. The efforts for increasing R&D are mostly related to the concept of "ecological modernisation". This seeks structural change on the macro-economic level through minimising the impact on environment through less reliance on resource-intensive industries, reorienting towards service and knowledge-based industries. Mostly all countries call for such a modernisation in their strategic objectives.

The common topics where R&D should be strengthened in this area and the similarities between the goals of different countries are outlined below:

a) **Research, technological development and innovation**: The target is to move towards an innovation-centred economy by strengthening the link between private and public research and support the transition from research to the development of products.
b) **Competitiveness**: R&D should be further promoted in various economic sectors, as the main driver for innovation and therefore productivity and competitiveness.
c) **Business and R&D**: The target is to increase the placement of R&D for sustainability on the private sector;
a) **Energy efficiency**: The main goal is to strengthen research on energy efficiency issues in key economic sectors; (i.e. transport, agriculture, industry, trade and services, tourism);
d) **Sustainable manufacturing**: The main aim of various strategies is to strengthen the role of the private sector in R&D. Measures aimed to provide advice and incentives and assist the manufacturing industry in energy conservation, water recycling and active engagement in R&D for innovation in both products and processes.

3.1.2 Environment and Sustainable Development

Common topics of environmental sustainability R&D oriented measures in mostly all strategies are:

b) **Biodiversity**: measures to ensure the ecological and biological research regarding the endangered species;
c) **Climate Change and Energy**: research on related factors triggering climate change, regulation and processes; inaction of climate change (social costs of climate change), impacts of climate change in various sectors
d) **Water quality and protection**;
e) **Resource management**.

3.1.3 Society and Sustainable Development

Although most countries have included in their strategies the aspects of social sustainability, mainly tackling these through adverting unsustainable trends in society (consumption patterns, social cohesion, integration, sustainable communities, changes in life style), only a few countries have specified measures towards the promotion of R&D in these fields. The strategies mostly emphasised the role of scientific research for reversing unsustainable societal choices, however, it remains unspecified which concrete topics need attention in this area. According to their strategies, countries as Austria, Germany, Cyprus, Hungary, United Kingdom have especially emphasised efforts in investing R&D in crucial areas of societal sustainability (i.e. sustainable living, quality of life).

3.1.4 Cross-cutting issues

The main focus of R&D measures in the cross-cutting topics was innovation. These measures are aimed at improving the general framework for research and innovation towards more eco-innovation or reorienting it to the needs of an SD model (described above). Most strategies address the R&D targets and measures on the following cross-cutting research areas:

a) **Education**: The targets in the majority of the strategies were the following: (1) to develop an educational system which is integral for R&D activities in SD relevant fields; (2) to promote research into environmental education; and (3) to ensure the effectiveness of SD education programmes.

b) **R&D and Innovation**: The focus has been on environmental, sociological and economic research for innovation in various sectors. The overall aim in the majority of the strategies is contribution of R&D and Innovation to the implementation of SD principles. The measures varied on a country-to-country basis.

c) **Sustainable Consumption and Production**: Mostly all countries have stressed the importance of increasing R&D in the production and consumption processes for more sustainable patterns. According to the strategies, R&D should be focussed on those sectors where the expected effects are most significant in terms of ecological progress and competitiveness (organic foods, water management technology, energy efficiency, urban transport, industrial processes, construction businesses)

4 Overview of national research programmes of two EU Member States

After the general overview of R&D targets in NSDS, this QR outlines the attempts of two countries in compiling and funding national research programmes for sustainable development. In most EU Member States, there have been diverse research programmes on various key fields of SD. The European Commission has also organised a workshop for providing an overview of Research for SD and the state of research in the various EU Member States is summarised in a workshop document (European Commission, 2007c). However, only a few countries have developed national research programmes on SD. Therefore, we choose to provide two good practices: the Austrian national framework strategy for research for SD (2004) and the German Framework programme on Research for SD (2010-2015). The two cases will include information on funding, research topics of SD, responsible institution and linkages of the research programmes to the NSDS target system.

4.1 Austrian framework strategy on research for sustainable development (FORNE)

The joint research initiative "Research for sustainable development" (FORNE-Forschung für Nachhaltige Entwicklung) was launched in 2004 by the Austrian Council for Research and Technological development. It responded to the need of further consolidating Austria's research for sustainable development for its international position and to nationally better coordinate the implementation of the Austrian Sustainable Development Strategy with the Austrian research programmes.

The initiative was then transformed to an overarching national framework strategy for research for sustainable development in 2004, which integrated all different research programmes under an umbrella of a common objective (see the sub-programmes in 4.1.1). The national programme was developed together by the Federal Ministry of Science and Research, the Federal Ministry of Transport, Innovation and Technology, the Federal Ministry of Agriculture, Forestry, Environment and Water Management and the Austrian Council for Research and Technology Development. The three ministries together with the Council also coordinate the program activities in the field of sustainable development (Paula *et al.*, 2004).

The framework strategy aims to integrate all different research programmes under a common strategic umbrella and to provide a coherent framework for orienting research for SD. The fundamental goals of FORNE are:

1) Improving living conditions and the environment by:
    a) Creating sustainable natural, social and technological systems and
    b) securing a viable economic location on a long-term basis
2) Improving competitiveness of the economy and science systems by:
    a) improving R&D
    b) securing a viable economic location on a long-term basis.

The objectives are valid for the various research programmes of FORNE, but are differently weighted. Moreover, the target system of FORNE is being continuously redeveloped. (FORNE Homepage) and adapted to the priority targets of the Austrian NSDS. The steering committee of the research framework strategy-FORNE and the Austrian Council for SD also hold regular meetings for coordinating the research strategy with the SD strategy targets system.

4.1.1 Research sub-programmes of the framework strategy for sustainable development (FORNE)

The FORNE framework strategy "Research for SD" in Austria includes various research sub-programmes of the three ministries which launched the joint initiative. These sub-programmes are aimed at implementing the strategic framework on "Research for SD". Moreover, they create the scientific basis for the country's sustainable development strategy. The sub-programmes can be divided into three categories:

1) The research programmes of the Federal Ministry of Science and Research, also known as "Pro-Vision-plus".

2) The research programmes of the Federal Ministry of Transport, Innovation and Technology are to be found under the Austrian Program on Technologies for Sustainable Development. The latter one is sub-divided into three other sub-programmes: “Building of tomorrow”, “Factory of tomorrow”, and “Energy systems of tomorrow”.
3) The research programmes of the Federal Ministry of Agriculture, Forestry, Environment and Water Management. (FORNE R&D Programme Report).

Box 1: Key findings on “Pro Vision plus” for nature and society

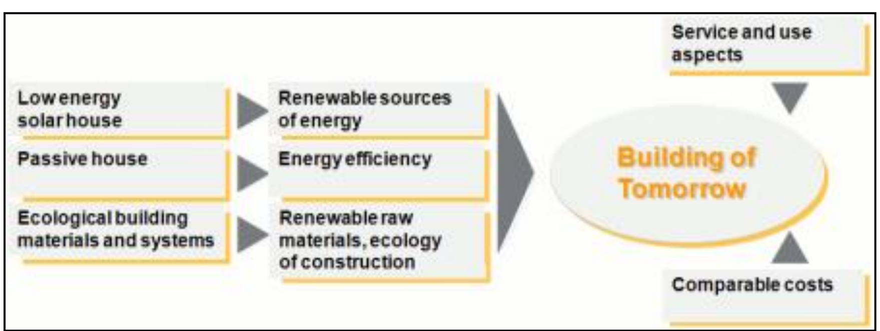
Focus: Pro-Vision-plus focuses on the relationships between climate change, spatial development and quality of life.
Objective: it is aimed at making knowledge available for solving the most urgent problems in provision for nature and society: adaptation to climate change and its consequences, suitable life and work models, responsible use of natural and industrial resources, and environmental protection.
Its core **topics** are:
Key issue 1: risk, uncertainty, vulnerability;
Key issue 2: sustainable living;
Key issue 3: integrated welfare;
Key issue 4: environmental balance;
Key issue 5: adaptable space;
Key issue 6: global responsibility;
Key issue 7: sustainability mediation
Duration: The provision programme is scheduled for a duration of 6 years, the first phase (2004 to 2006) and second phase (2006 to 2010). At the moment there is no information what will happen with the programme in the future.
Sponsor: Federal Ministry of Science and Research.
Budget: The Budget for 2004-2007 was in total €7,1 Mio.
Selection of projects: research projects are mostly selected by means of tender procedure.

Source: Pro-vision Homepage

Box 2: Key findings on Austrian program on technologies for sustainable development

The programme “Technologies for sustainable development” initiates and supports trend-setting research and development projects concentrated on technological innovations. The program pursues clearly defined emphases, selects projects by means of tendering procedures and is characterized by networking between individual research projects and by accompanying project management. The Ministry invites tenders in three subprograms:

Building of tomorrow:
Focus: The sub-programme “Building tomorrow” focuses the residential and office building that



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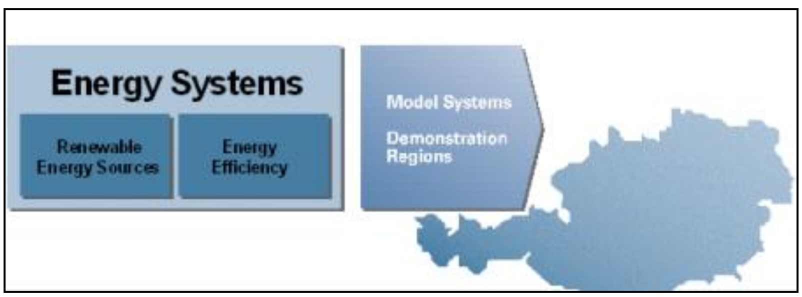
feature improvements as compared to current buildings in Austria, in topics such as energy efficiency, renewable energy sources, renewable, raw materials, service and user-related aspects and settlement structures.
Duration: It has been scheduled for a duration of 5 to 8 years (until 2008). From 2008, the programme will be extended until 2011.
Budget: from 1999-2007: €250 Mio and from 2008-2011: € 35 Mio.

Factory of tomorrow:
Focus: The sub-programme „Factory of Tomorrow"addresses the trade and industry as well as service enterprises that produce and provide products of tomorrow using materials of tomorrow to meet tomorrow's needs.
Goal: The goal is to encourage the development and implementation of trend-setting technology in enterprises. Topics treated are: production processes, renewable raw materials, and new concepts for the products.
Duration: It is scheduled for duration of 9 years (2000-2009). Currently, there are no tenders open as the programme is in a redesign phase. The Programme will be then further developed to a new programme named "Smart production".
Budget: From 2001-2008 there have been 5 tenders with a budget of € 23 Mio.

Energy systems of tomorrow:
Focus: The programme "Energy system of tomorrow" refers to service oriented reliable and cost–efficient technologies using different predominantly renewable sources of energy. The topics are energy efficiency, the use of renewable energy sources, systems innovations and strategies.



Goal: The goal is the development of technologies and concepts for efficient energy systems that rely on use of renewable energy systems, by taking in consideration regional peculiarities.
Duration: It is scheduled for duration of 9 years (2003- 2007). Since 2007 the programme was leaded over to the new **New Energy 2020.**
Budget: So far there have been two tenders open. The Budget for New Energy 2020 will be € 35 Mio per year. No information is available on how much money was flowing in the first two tenders in the period 2003-2007.

Source: Homepage of Austrian Programme "Technologies for sustainable development"

Box 3: PFEIL 10: Programme for Research and Development in the Federal Ministry for Agriculture, Forestry, Environment and Water Management.

Focus: plans to conduct research in state owned institution and as well commissioning research in its four strategy areas: rural areas, farming and food, water, environment and waste management.

Objective: to build and focus research activities of the ministry through interdisciplinary co-operation, to utilize efficiently research results in order to secure quality of life.
Duration: PFEIl 10 is the successor of PFEIL 05.The programme is renewed every five year. PFEIL 15 is also already being planned.
Sponsor: The Federal Ministry for Agriculture, Forestry, Environment and Water Management
Budget: The budget for PFEIL 10(2006-2010) is € 94, 8 Mio.
Selection of projects: Possible procedures include top-down as bottom-up approaches, calls for tenders, search for interested actors in the strategic topics search for stand alone projects, which are used depending on the respective objectives.

Source: Federal Ministry for Agriculture, Forestry, Environment and Water Management, 2005

All three framework programmes Pro-Vision, the Austrian Programme on technologies for sustainable development and PFEIL 10, are to be adjusted to the target system of the FORNE framework strategy for "Research on Sustainable Development".

In the Austrian research framework for sustainable development, all three sub-programmes include key topics relevant to sustainable development. They are funded from the public sector (national government ministries). While the programme "Technologies for Sustainable Development" is run by the Federal Ministry of Transport, Innovation and Technology, it is primarily aimed at technological innovations; on the other hand Pro Vision-plus investigates the impact of climate change on ecosystems, regional development and quality of life. Ethical dimensions are also taken into consideration, while the programmes use participative methods. PEFIL 10 concentrates the research funding on topics of importance to environmental management, such as biodiversity, resources management, land usage and other sub-domains under its aforementioned strategic fields. As one of the programmes of FORNE, it also concentrates funding for research for sustainable development (indicators, impact assessment, education for sustainable development). The programmes are still running under the framework strategy of FORNE though it is not clear how the FORNE strategy will be further developed and how much it will be considered in the future Austrian research programmes.

4.2 German Framework Programme "Research for Sustainable Development"

In order to meet the EU's "20-20-20" targets for 2020, Germany has set up an ambitious new framework programme "Research for Sustainable Development" [Forschung für Nachhaltige Entwicklung-FONA] on 2 February 2010. Until the year 2015, the Federal Ministry of Education and Research will be providing funds of over € 2 billion for the development of sustainable innovations (BMBF, 2009: 11).

Within this new framework programme, Germany aims at strengthening its position as an exporting nation and technological leader. Therefore, the activities in this programme particularly concentrate on the advancement of technologies in the area of climate protection, resource efficiency and future-oriented energy supply which are supposed to open up new markets for eco-innovations. Furthermore, through its Framework Programme the Federal Ministry of Education and Research will consistently implement the German national sustainable development strategy (NSDS) in the field of energy efficiency and land usage and the High-Tech Strategy in the field of Climate Energy and Resources.

The specific targets of the new framework programme are:

1) To reach the international agreed targets of tackling climate change, by aiming at a 40 % reduction of green gas emissions until 2020;
2) To establish a sustainable energy supply, by 20% increase of the share of renewable and by doubling the energy productivity compared to the levels of 1990;
3) To conserve natural resources, biodiversity, and raw materials, by doubling the raw material productivity until 2020, and decreasing land usage form 130 to 30 ha per day;
4) To affect societal change in line with the requirements of sustainable development (BMBF, 2009).

The Federal Ministry of Education and Research is responsible for the coordination and management of the framework programme and, by so doing, is supported by an advisory board of external experts. The website of the Framework Programme has been launched and annual conferences organised in order to foster networking activities between stakeholders from politics, science, economy and the society. Figure 12 displays the distribution of different actors who are involved in research projects and networking activities.

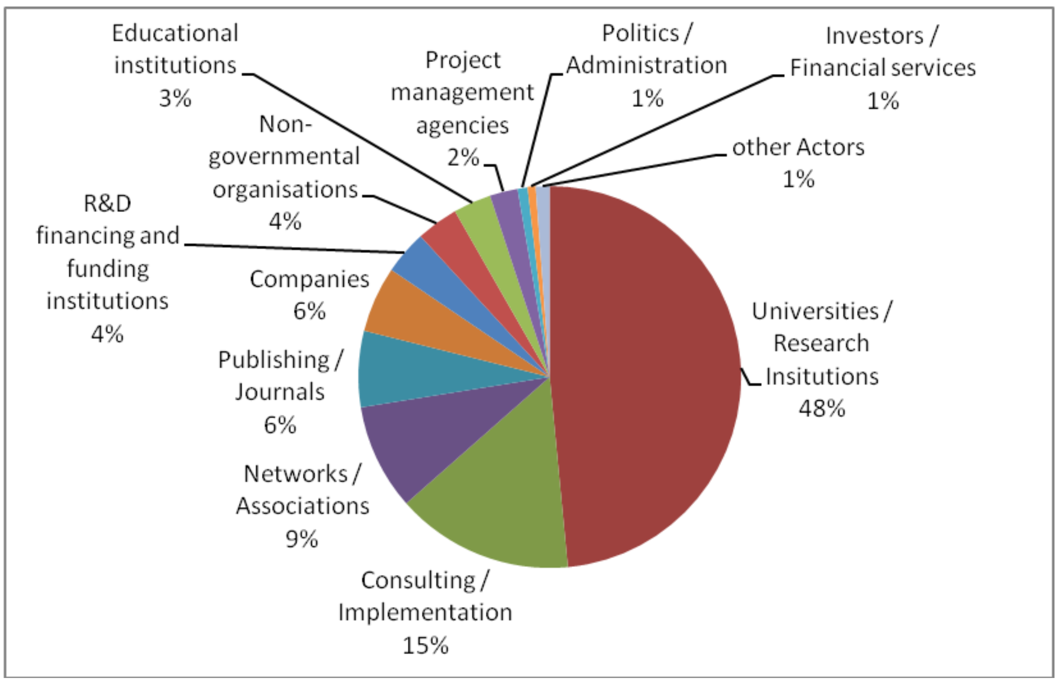


Figure 12: Actors involved in research projects and networking activities (*Source:* Retrieved from http://www.fona.de/en/actors.php)

4.2.1 Action fields of Research framework programme for sustainable development

The Research Framework Programme includes the following central fields of action:

a) **Global responsibility - International networking**
b) **Earth system and geo-technologies**
c) **Climate and energy**
d) **Sustainable economy and resources**

e) Social developments

These five fields of action are narrowed down into research focal points (see Table 2 below). These fields will be supplemented with research on cross-cutting issues such as "sustainable land management", "economy and sustainable development" and "giant equipments and research infrastructure (i.e. earth observing satellites)". In these cross-cutting fields, perspectives of natural-technological sciences will be combined with perspectives of economic-social sciences, in order to provide a systemic and integrative approach towards the recommended actions and measures.

The highest amount of funding is provided for "sustainable economy and resources" with € 430 Mio in the sub-field of water management and chemical processes. The second highest to "system earth" with € 192 Mio, followed by "global responsibility" with € 162 Mio, "climate and energy with € 74 Mio and research on "society" with € 47 Mio. Already completed projects from former Framework Programmes in the research focal points of "peace building" ("Social developments") and "water resources" ("Sustainable economy and resources") are, for instance, "Humanitarian mine sweeping" and "GLOWA – Global change and water cycle".

Table 2: Research focal points for 2010-2015

	Budget for 2010-2015
Global responsibility	
Dialogue on SD research	3 Mio.
ERA NET Eco-Innovera	4 Mio.
Knowlegde centers for climate change in Africa	95 Mio.
International Partnerships for Environment and Climate change technologies	60 Mio.
System earth	
Geo-technologies program	30 Mio.
CO^2 storage in substrate	67 Mio.
Key regions for system earth	35 Mio.
Dynamic earth system -modelling	60 Mio.
Climate and energy	
Economics of climate	12 Mio.
Medium-term climate forecasting	20 Mio.
Climate and Ecological system services	42 Mio.
Sustainable economy and resources	
Small and Medium enterprises Innovation	80 Mio.
Chemical processes and material usage of CO^2	100 Mio.
Sustainable water management	200 Mio.
Innovative system solutions in land management	50 Mio.
Society	
Social dimension of climate change and protection	9 Mio
Sustainable Consumption	10 Mio.
Networking of environmental research NGOs	2 Mio.
Economic sciences for SD	9 Mio.
Socio-ecological research	17 Mio.

Source: BMFB, 2009: 12.

The Framework Programme "Research for Sustainable Development" is realising through public tenders of central fields of action. The best project proposals will be chosen during a competitive selection procedure. The programme is relatively open-ended and flexible thus allowing engaging in new additional fields of action. Therefore, the framework programme aims to adapt to new scientific, technological or societal developments by changing priorities in the research agenda. Promotional activities include a wide variety of items: provision and facilitation of research infrastructure (e.g. large scale installations), promotion of institutional capacity (financial support for research institutions), promotion of young scientists (working groups guided by young PhDs).

Box 4: Key findings

Focus: the promotion of eco-innovations
Duration: from 2010 to 2015
Budget: € 2 billion
Sponsor: Federal Ministry of Education and Research
Topics: specification of central fields of research; narrowed down to so-called focal points:
Selection of project: project proposals without tender procedures; networking activities: annual conferences and website; variety of promotional activities: funding of institutions and projects.

Generally, with this research programme for sustainable development, Germany has attempted to meet the targets of tackling climate change, energy efficiency, natural resource management and societal change for sustainable development. Moreover, it implicitly contributes to the implementation of the NSDS targets for energy efficiency, land management, sustainable production and other key objectives. The Research Framework Programme has distributed research funding between environmental, economic, societal and global aspects of sustainable development, by strengthening research specifically in the field of economy and sustainable development.

To conclude, both countries have been active in defining national research programmes for sustainable development and adapting the research framework to the target system of the national strategies for sustainable development by providing a scientific base for the NSDS. These programmes include key topics relevant to sustainable development and are funded by the public sector. Both countries have also arranged the necessary institutional settings and collaboration processes for an effective coordination of research priorities for sustainable development between the ministries and between research programmes and national strategies for sustainable development. However, a detailed prescription of the linkages of research programs for sustainable development and the national strategies goes beyond the scope of this report and might be dealt with in forthcoming works.

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