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Options for Strengthening Responsible Research and Innovation

Report of the Expert Group on the State of Art in Europe
on Responsible Research and Innovation

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Executive summary

Research and Innovation are a key pillar in the strategy of the European Union to create sustainable, inclusive growth and prosperity and address the societal challenges of Europe and the world. The need to gear the innovation process to societal needs is reflected in many high-level policy, strategy and programming documents, such as the Europe 2020 strategy (2010) and the Horizon 2020 framework programme proposal (2011). Furthermore, for example the Lund Declaration (2009) underlines the importance of addressing societal needs and ethical questions in research and development, as well as the Council conclusions on the Social Dimension of the European Research Area (2010).

To achieve better alignment of research and innovation with societal needs a number of initiatives have been undertaken by EU Member States and the European Commission. These initiatives have shown that there is a need for a comprehensive approach to achieve such an improved alignment. **Responsible Research and Innovation (RRI)** refers to the comprehensive approach of proceeding in research and innovation in ways that allow all stakeholders that are involved in the processes of research and innovation at an early stage (A) to obtain relevant knowledge on the consequences of the outcomes of their actions and on the range of options open to them and (B) to effectively evaluate both outcomes and options in terms of societal needs and moral values and (C) to use these considerations (under A and B) as functional requirements for design and development of new research, products and services. The RRI approach has to be a key part of the research and innovation process and should be established as a collective, inclusive and system-wide approach.

This expert group report identifies policy options for strengthening Responsible Research and Innovation. In **chapter 1**, the needs for action, and in particular European action is demonstrated. This chapter shows that there are many examples in which the outcomes of research has been contested in society, because societal impacts and ethical aspects have not adequately been taken into consideration in the development of innovation. In many cases, the related research funding was wasted. On the other hand, there are many cases in which the successful and early consideration of societal needs has brought up innovation which were particular successful also in economic terms. Hence, the early consideration of RRI aspects can contribute to developing lead markets for innovation serving societal needs. Furthermore, the chapter describes examples of unattended fields: these are fields of innovation which have a high economic and societal potential, but market forces in itself are insufficient to provide the necessary incentives for investment in these fields. Finally, the chapter identifies many different approaches among European and national actors in research and innovation policies to overcome the situation. Many different concepts and policies are in development to overcome the situation. There is a need to better coordinate these efforts in order to avoid failed investments in research and innovation, and in order to better exploit the potential of considering societal needs in innovation. This is very much in line with the aforementioned Europe 2020 strategy and the need for better alignment of research and innovation with societal challenges.

In **chapter 2**, policy objectives for RRI are defined, with a view to the achievement of the Europe 2020 objectives, and in particular those of the Innovation Union and the European Research Area. The key objective of EU action should be to develop a coherent approach among the EU Member States that defines processes, instruments and criteria for RRI that on the one hand encourage researchers and innovative firms to consider ethical concerns and address societal needs. A framework for the operationalization of RRI entails (a) defining criteria for RRI, (b) defining processes for a successful application of RRI, and (c) Defining instruments to encourage RRI.

In **chapter 3**, four main policy scenarios are presented. Option 1, 'business as usual' implies that the existing approaches to address RRI in EU funding programmes would continue to be the main tools to promote RRI at the EU level. There would neither be any additional efforts to address RRI in the upcoming funding programmes like Horizon 2020 nor any new funding opportunities to address RRI. Furthermore, actions on RRI in EU Member States and potentially also private businesses would continue but there would neither be any attempts to coordinate the different approaches towards RRI, nor to initiate a process for the development of a common European understanding of RRI. The standards for RRI would remain scattered.

Option 2 is an 'improved business as usual', with specific funding for RRI. This would entail several actions. One action would be to 'mainstream' RRI in the existing funding programmes. In this case no new funding opportunities on RRI would be allocated, but criteria for RRI would have to be applied across all EU funding programmes. This would not only raise awareness for RRI but also create greater transparency with regard to the provisions for taking into account societal needs and ethical aspects in the proposed research. A second action under option 2 would be an increased share of funding for inter- and transdisciplinary research, including funding options for stakeholder participation in the research process, so as to further encourage research that more directly takes societal needs into account. A third action would be a specific funding line for research on RRI. There is still a need for more information on the interactions of science, innovation and society, which needs further development of the theoretical approaches and the study of conditions for a successful application of RRI in practice.

Option 3 entails 'Improved coordination with the EU Member States without a legally binding initiative'. This option goes beyond strengthening RRI in the existing funding programmes of the EU. It includes directly addressing the Member States as well as business enterprises, research institutions and public and private research funders. However, option 3 and option 2 are not mutually exclusive, but can be used as complementary tools to promote RRI. Option 3 is process-oriented, aiming at fostering the dialogue on RRI enhancement and improving the transparency with regard to RRI activities in the Member States. It creates a framework enabling policy makers, researchers and business enterprises to put a stronger emphasis on RRI by raising awareness for the issue, but also by changing education and setting incentives for applying RRI in both research and innovation. This option would have several action lines, one being to establish a framework for enhancing cooperation on RRI activities. This framework can be accompanied with a reporting scheme on RRI activities. The framework would involve for example trainings on RRI for researchers, and funding schemes for RRI within existing Member States funding programmes. The latter could also

be linked to EU initiatives such as Joint Programming Initiatives (JPIs) and European Innovation Partnerships (EIP). The framework could also use public procurement as a policy instrument, to set incentives for business enterprises. Member States can thus stimulate RRI in innovation processes by using public procurement to start pre-commercial projects and to purchase innovative and sustainable products. Another action line would be to establish Codes of Conduct for RRI activities. Codes of conduct are a method of self-governance by which researchers and innovators can agree on norms or standards. A third action line would furthermore be to establish Standards on RRI that can be adopted voluntarily. This would imply the development of a common framework for RRI that is applicable to the design of research processes that can the shape of European standards and establish a benchmarking process for RRI. This process can be organised in a similar way as the formulation of the ISO norm 26000, which provides guidance on Corporate Social Responsibility (CSR) practice in business enterprises and other organisations.

A 4th option can also be identified, which is 'Improved coordination with the Member States with a legally binding initiative'. This option is similar to option 3, but follows a more top-down approach in which mandatory guidelines would be implemented via European Regulations or Directives.

Chapter 4 presents an analysis of the impacts of the various policy options. Assessing the impacts is difficult as some of the options are designed to initiate or enhance development processes for RRI activities rather than suggesting concrete measures. Furthermore, at this early stage costs will be easier to measure than benefits and the latter have to be measured more implicitly.

The impacts of the first option, "business as usual" have been described in the first chapter: currently, there is a lack of incentives for considering RRI aspects in R&D processes, as well as a lack of awareness about RRI. This option does not entail direct additional cost, but it would imply that the potential of research funding is still not fully exploited. Indirectly, this leads to costs for business enterprises and research institutions that could have developed more successful products, for research funders who could have spent their funding more efficiently and for consumers who do not necessarily receive products that serve their interests in the best possible way. Furthermore, without any initiative to coordinate current RRI initiatives in some of the Member States, the European landscape on RRI will be fragmented, which in turn can be counterproductive for the Innovation Union and the Single Market.

Option 2, 'improved business as usual' with specific funding for RRI, directly affects the EU as research funding body and all public and private research institutions that apply for funding from these funding programmes. Impacts can be identified for the respective actions under this option. The first action under this option, to 'mainstream' RRI in the existing funding programmes will ask researchers to reflect on ethical questions and questions of social needs, and therefore likely prompt more nuanced research proposals and lead to new disciplinary connections. The administrative burden resulting from this action is regarded as rather low for the researchers applying for funding as well as for review process of the proposals. At the same time, the capacities for achieving major progress in better aligning EU innovation with societal needs, and harmonization in EU innovation policy generally, remain limited. The second action under option 2, to increase the share of funding for inter-

and transdisciplinary research, would also amount to only low administrative costs. On the other hand, more inter- and trans-disciplinary research should nurture greater innovation and creativity, and make it more likely that research and innovation are directly targeted at solving societal challenges. This option can also lead to 'second order impacts' such as increasing trust in research and innovation and changing mind-sets. However, the harmonization capacity of this option is very low as it is limited to a small amount of EU funding only. The third action, to include a specific funding line for research on RRI, would amount to only low administrative costs as it would entail not much more than the budget dedicated to this funding line. The major impacts of this option will be visible in long-term developments, such as changed science and innovation policy and funding schemes and in second order impacts, rather than in directly connected short term outcomes.

Option 3, 'Improved coordination with the EU Member States without a legally binding initiative', covers a wider range of actors and will affect a larger amount of funding than option 1 and 2. It is very difficult to measure the exact impacts of the actions of option 3 but it can be expected that the economic impacts will be positive in terms of a reduced risk of innovations failing after market introduction and consequently higher efficiency of public and private research funding. The actions furthermore have positive social impacts, e.g. more socially and environmentally sustainable products, increased awareness for gender issues in R&D, etc. Because option 3 is directed to all involved actors, the capacity to lead to 'second order impacts' (trust, changing mind-sets) is high. The harmonization capacity generally of this option is also higher. At the same time, this option offers a high degree of flexibility as the adoption of the proposed standards and norms are voluntary and can be contextualised according to Member States' needs.

The first set of actions under option 3, aimed at improved coordination of RRI activities in the Member States, naturally has a very high harmonization capacity and addresses all actors involved in research and innovation processes. However, the costs for implementing this set of actions, especially the reporting scheme, can be regarded as high compared to the other actions. Setting incentives for RRI, in particular via public procurement of goods and services, would have significant positive impacts, while the administrative costs for implementing such incentives would be low.

The impacts of the second set of actions under option 3, involving Codes of Conduct for RRI, are difficult to assess and the associated costs depend on various factors. Generally however, they can lead to an improved efficiency of research funding and the administrative costs would be rather low.

The impacts of the third set of actions under option 3, standards on RRI, are mostly indirect as the adoption of such standards would be voluntary. Nevertheless, an RRI 'ISO standard' would directly address business enterprises and of relevance to all actors in the innovation system. The costs for introducing such a standard would be low.

Option 4, 'Improved coordination with the MS with a legally binding would reach the highest possible level of cohesion. On the other hand, there are several reasons why a binding initiative can be counterproductive in the short run. There would be administrative costs and a legally binding regulation would also result in costs for business enterprises and research

institutions, which would have to adapt their research and innovation processes accordingly. Also, a legally binding initiative would be less flexible and would be able to take into account, or benefit from, the diversity of action of the Member States at the beginning of a process of harmonisation and convergence. Finally, it can be questioned whether a legally binding initiative would be supported by the Member States and is in accordance with the European Union's competences in this area.

Chapter 5 gives a short comparison of the options. The analysis in chapter 4 shows that option 2 to 4 all offer the opportunity to improve the efficiency of research funding by enhancing the consideration of societal needs and ethical aspects in research and innovation processes. A concrete quantitatively assessment is not possible at this point as the options suggested here are mainly about initializing processes to develop new funding programs, standards and norms for RRI. Their impacts will depend on policy initiatives on the national and EU level. However, the options that address a wider range of actors and a larger amount of research funding will have greater impacts on the efficiency of research funding. In this light, policy option 3 is preferable. It offers enough flexibility and can be adapted to the respective contexts, while still providing the opportunity to harmonize approaches in the EU and to further develop them in the same direction. The actions suggested in option 2 should also be considered, because they complement the actions in option 3 on the EU level instead of them being mutually exclusive.

Chapter 6 briefly lays out the options for policy monitoring and evaluation. This should encompass both the policy measures taken and outcomes of these efforts. Progress report should be produced that include a review of the implementation efforts of the Commission's recommendations and voluntary codes, the take-up of funding for RRI activities provided by the EU's and national funding schemes, and the improvements in the cooperation among the Member States. It should also include an evaluation of the effects on the different actor groups and the impacts on the underlying causes that have been identified in chapter one. This evaluation scheme can also be benchmarked with other available frameworks, methodologies and indicators. Especially, the complexity and the long term character of the impacts should be taken into account, as well as the interrelation between the Member States levels, the European and even the international level.

Finally, **Annex I** presents an extended definition of RRI, while **Annex II, II and IV** give examples of contested innovations, successful innovations and unattended field of innovation respectively.

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1 Identifying the problem

1.1 The extent of the problem

It is the ambition of the European Union to ensure that research and innovative ideas can be turned into products and services that create jobs and prosperity, as well as help preserve the environment and meet the societal needs of Europe and the world. To achieve this, the European institutions, its Member States and private business actors invest considerable monetary and human resources into Research, Development and Innovation. The need to gear the innovation process to societal needs is reflected in many high-level policy, strategy and programming documents, such as the objective of the EU 2020 strategy to create smart growth or the Horizon 2020 programme that defines tackling societal challenges as one of the main priorities. (EC 2011b; EC 2010a)

In addition to this, it is widely acknowledged that there is a need to better incorporate ethical concerns in research and innovation. The Lund Declaration (2009) underlines the importance of addressing societal needs and ethical questions in research and development as well as the Council conclusions on the Social Dimension of the ERA (EC 2010b). However, it is often unclear to what extent the current efforts actually contribute to meeting these Grand Challenges. These challenges are often of a highly complex nature crossing different policy areas social affairs, health or the environment. Examples of such challenges are climate change, ageing populations or food safety. At the same time, economic opportunities may open up through addressing the Grand Challenges. Hence, they also present opportunities, which are not fully utilized yet.

Nanotechnologies

Nanotechnology is one of the key enabling technologies identified by the European Commission, which uses nanotechnology as “an umbrella term that covers the design, characterisation, production and application of structures, devices and systems by controlling shape and size at nanometer scale” (European Commission 2009a). In 2007, the estimations of the global market for nanotechnology has been estimated to over \$ 3 trillion by 2015 (LuxResearch (2009): “Nanomaterials of the Market Q1 2009: Cleantech’s Dollar Investments, Penny Returns”). However, recent forecast have lower expectations of \$ 1.6 trillion (<http://www.reportlinker.com/p0118193-summary/Nanotechnology-Market-Forecast-to.html>). Furthermore, the investments by governments, corporations, and venture capitalists in nanotechnology are meanwhile stagnating at around \$18 billion (Lux Nanotechnology Funding: Corporations Grab the Reins 2011). Finally, the European Commission (EC 2009a) realized that commercialising these research efforts is particularly difficult in Europe. It perceives the concerns related to environmental, health and safety (EHS) issues and it is aware that standardisation and public opinion needs to be addressed to ensure market acceptance and the deployment of nanotechnology. However, the European Commission adopted already in February 2008 the Code of Conduct for Responsible Nanosciences and Nanotechnologies Research (EC 2008). Furthermore, developed markets such as, the US, France, Germany etc. have drafted regulations for the nanotechnology industry long time back, the nanotechnology market is still at its nascent stage and has not benefitted from these regulatory framework conditions. Consequently, both code of conducts emphasizing responsible research and regulations focusing on industry activities related to nanotechnology have not yet been able to promote the commercializing of nanotechnology based products, which is necessary to achieve a positive return on investment both for the private and the public spending in research and development.

To overcome this and in order to gear research, development and innovation more effectively to societal needs and ethical concerns, a number of European Member States as well as the European Commission itself have undertaken a number of initiatives. These initiatives include

- considering societal needs and ethical aspects in research funding programs, e.g. through public and stakeholder dialogue;
- developing criteria for the early appraisal of research and innovation, e.g. technology assessments;
- establishing processes to better integrate societal needs in research and innovation, e.g. transdisciplinary approaches in sustainability science;
- setting up advisory bodies such as councils on ethical aspects of new technologies.

These activities, and the rationales behind them, fall under the umbrella of 'Responsible Research and Innovation' (RRI). RRI seeks to connect research and innovation with the futures in which they play a part. Even if some Member States have the ambition to establish their own framework for RRI there is currently a lack of coherent approach for developing common criteria or establish processes among the Member States. Moreover, not all aspects of RRI are fully covered in the current approaches yet.

A policy for RRI would bring together the above mentioned efforts by the Member States and provide a comprehensive framework for improved governance. RRI refers to ways of proceeding in Research and Innovation that allow those who initiate and are involved in these processes at an early stage (A) to obtain relevant knowledge on the consequences of the outcomes of their actions and on the range of options open to them and (B) to effectively evaluate both outcomes and options in terms of ethical values (including, but not limited to well-being, justice, equality, privacy, autonomy, safety, security, sustainability, accountability, democracy and efficiency) and (C) to use these considerations (under A and B) as functional requirements for design and development of new research, products and services.

The need for a comprehensive and common approach to develop processes and standards for RRI can be demonstrated by (1) many examples of innovations which have been contested or have failed, because social needs and ethical concerns were not taken into account in due time and (2) examples of how due attention to value requirements can act as a driver of innovation. Anticipating and measuring the costs of stranded research and innovation (R&I) public investments in case of induced social unrest, ethical controversy and weak or non-existent demand will be beneficial in times of increasingly limited financial means but is also very difficult.

1.2 Contested Innovation

There are countless examples of innovation that have been contested by societal actors because of ethical concerns or because of their failure to meet societal needs. These examples of innovations have in common that

- their technical and economic feasibility has been demonstrated,

- there is an apparent sound ethical reason to adopt or implement them,
- large investments have been undertaken,
- they have been contested and frustrated on the basis of security, social or ethical concerns.

For example, Carbon Capture and Storage (CCS) technologies are highly contested in many Member States (Eurobarometer 2011). Citizens raise safety concerns over storage facilities in their neighbourhood although this technology is regarded as potentially beneficial to fighting climate change. Smart energy meters are another example of a contested innovation. For example, in the Netherlands the roll-out of smart metering has been delayed because of concerns regarding privacy issues. Similarly, electronic health records are highly contested because of privacy concerns although they are also regarded as potentially beneficial to simplify medical treatment or prevent medical errors. A more detailed description of these examples can be found in Annex II.

Other examples of contested technologies include the following (see also Eurobarometer 2005):

- Nanotechnologies
- Genetically modified organisms
- E-Mobility
- Stem Cell Research
- Online social networks
- Biotechnology
- Dual-use robotics
- Nuclear technology
- Military and security technologies

What is common to these examples is the fact that considerable investments have been made to develop these innovations. Still societal needs and ethical concerns regarding these innovations were not adequately identified at the outset and were insufficiently incorporated in their design and development. While it is difficult to estimate the costs of failed innovations, these cases show that an early consideration of ethical aspects and societal needs contributes to a more efficient spending of resources for research, development and innovation. The risks, concerns and uncertainties of new technologies oftentimes are considered only at a late stage, often just before market introduction (e.g. in case of products based on nanoparticles (BAuA 2006)) and their implications are not made to bear upon the design and development of new research, products and services. Public policies and business can react with moratoriums to those innovations, which can ultimately lead to stranded investments that cannot be recovered.

Genetically Modified Organisms

The European Commission funding of research on GMO safety sums up to more than EUR 300 million since its inception in 1982 in the Biomolecular Engineering programme (European Commission 2010: A decade of EU-funded GMO research (2001 – 2010)). However, the majority of European citizens do not support GM food and the comparison between 2010 and 2005 shows no substantial changes in the public's perception of GM food. (Gaskell et al. (2010): Europeans and biotechnology in 2010: Winds of change? A report to the European Commission's Directorate-General for Research). The dimension that differentiates supporters and opponents is the issue of safety. In addition to the ambivalent perceptions by EU citizens, 20 years after the first EU directive on deliberate release was released, the issue of GM crops and food is still unresolved. Only two crops have formal approval for cultivation and only six countries have planted GM crops, e.g. Spain and Poland, less than 100,000 hectares in total in 2009, compared to more than 100 million hectares world wide. Furthermore, currently six countries have bans on GMOs using the 'safeguard clause', e.g. France, and Germany. Italy has said that it will defy the EC and refuse to allow GM crop to be grown, but has not done so formally. Confronted by this heterogeneity, the European Commission is taking the subsidiarity route. Member States have the legal right to decide whether to cultivate GM crops or not.

In summary, despite the investment in GMO safety, European citizens do not support GM food and there is a great heterogeneity within the Member States. Obviously, there are deep concerns in the European society related to GMOs, which have not been resolved and lead consequently to a low and even to no commercialization of GMOs in Europe compared to the rest of the world.

1.3 Successful innovations

Taking ethical concerns and societal needs better into account brings considerable economic benefits. Ethics is often seen as an impediment to economic growth, but it can serve as a driver for new areas in research and innovations, creating jobs, increasing social welfare and helping to avoid risks of misallocation of R&D funds, as the growing economic importance of green technologies across Europe shows. Also, some of the globally leading groups regarding the development of privacy enhancing and security technologies are located in Europe, which evolved as a response to strict privacy regulations in Europe. (See Annex III) Moreover, there are Lead Markets, which are driven by innovation, for several societally desirable products located in Europe. This should put the EU in a favourable position to gain from the growing demand for these products on the world markets. Examples for these highly innovative products, that provide solutions for societal, environmental or economic challenges while having a strong industrial base in Europe, are sustainable constructing, recycling technologies or protective textiles (see EC 2007 for the Lead Market Initiative).

There are a number of other innovation which serve societal needs and in which Europe has taken over a leading role (EC 2009b), e.g.

- Resource efficiency: bio-based products
- eHealth: e.g. medical imaging
- Renewable energies
- Privacy by Design: new generation of software and ICT services that respect privacy while offering desired functionality

There are emerging areas of research and innovation in which we can see the lessons from past technologies starting to make a difference. In recent debates and research around geoengineering, for example, we have seen a recognition of the need to acknowledge social needs and ethical concerns from the outset. This has laid the groundwork for a responsible approach.

Geoengineering: A test-case for responsible innovation

Research into geoengineering, the deliberate manipulation of the earth's climate, has attracted attention both because of its scientific interest and the ethical questions that it raises. Though technologies are not yet available with which to geoengineer the Earth's climate, recent assessments from the UK's Royal Society and others suggest that they might be developed in the coming decades and, if deployed, have vast and unpredictable consequences alongside their intended impacts. Stakeholders (including many scientists) are concerned that research in such an area might distract from policy efforts towards mitigation of carbon emissions. Many are concerned that technologies will be deployed before we understand their implications, or that they will be used as weapons. The testing of such technologies is problematic, as they are intended to have planetary effects, so most researchers agree that there is a need to proceed with caution and clarify a responsible approach. So far, geoengineering looks to be a good example of responsible innovation in action. Efforts are underway at different levels (led by National Academies, research funders, scientists, international governance bodies and others) to govern research and innovation. Researchers have initiated public dialogue activities, sought to proactively engage with stakeholders and drawn up codes of conduct. In the UK, some of the world's first geoengineering projects have been funded by the EPSRC, NERC and STFC. They have tried from the start to incorporate social science and ethics perspectives. In May 2012, the Economic and Social Research Council announced a major project on geoengineering governance. Initiatives such as the Solar Radiation Management Governance Initiative, created by the Royal Society and other partners, have sought to understand the emerging issue in all its complexity. A set of early principles for research governance - the 'Oxford principles' - have attracted a good deal of attention, setting some ground rules for progress in the area. The risk is that research accelerates away from these emerging governance structures as scientific and political interest in the area builds.

1.4 Unattended fields

Finally, it is worth noting that many societal needs around the globe have not yet received a lot of attention from researchers, companies and governments, despite the enormous potential for innovative solutions which accommodate widely shared public values. Some areas where there is clear potential for RRI are:

- Development policies
- Social cohesion
- Translational Innovation in underdeveloped areas
- Poverty dynamics
- Neglected and rare diseases
- Scarce Resources management

These “orphan” areas are not only present in third world countries, but also manifest themselves in important sectors in our modern European societies, which are also at risk of injustices and inequities in economic, cultural, information, technological, social or environmental domains. Investing in research and innovation in these orphan areas requires commitments at different levels: policy making, programming, but also at the individual level, e.g. the awareness of researchers, entrepreneurs and civil society. These areas represent intellectual challenges (SaP 2010) worth exploring for researchers, who would otherwise never pay attention to those clusters of problems and would as a consequence also forgo business opportunities for companies that may create virtuous economic dynamics in depressed areas or social sectors (see the success of orphan drugs meanwhile fostered by orphan drug regulations providing exclusive market access to those pharmaceutical companies committed to make significant investments to look for solution to remedy rare diseases (see Blind et al. 2004).

Annex IV shows examples for opportunities in science and business regarding these neglected areas.

1.5 The underlying causes

RRI has the potential to make research and innovation investments more efficient, while at the same time focusing on global societal challenges. Although there seems a general and growing awareness of the importance of RRI, these aspects are not routinely taken into account by the research system or by markets or systems of innovation.

Systems of innovation have different properties and dynamics and therefore it seems appropriate to identify the barriers as well as underlying drivers for RRI in both systems separately.

While research (OECD 1993) is concerned with knowledge generation to fully understand all aspects of a field of study or discipline and aims at exploring the unknown and at generating new ideas, innovation goes one step further. Innovation (OECD 1993) builds on the development of new ideas but typically is accompanied by the intention of making commercial use of new ideas and their expression in products, systems and services. Hence, the aspiration of success on the market is an important driver for innovation (Swann 2009).

Markets provide incentives via prices for the development and supply of technologies. Innovation systems function well in terms of technical feasibility and economic efficiency provided by markets, but markets are typically not suitable to take into account ethical concerns or societal needs, which do not translate immediately into prices, because these externalities cannot be internalised due to complex causalities, e.g. in the case of environmental damages.

In particular, the innovation system often fails to anticipate future societal needs, especially when it comes to problems in the distant future of future generations or groups without a voice. On the one hand, it is difficult to foresee future issues and appropriate solutions, because they are prospective. On the other hand, returns from investments in these kinds of societal needs are also unknown, risky and only in the distant future, i.e. heavily discounted,

and therefore less attractive for business enterprises bearing large investment costs today, which should be re-appropriated in short time horizons in order to achieve positive returns on investments.

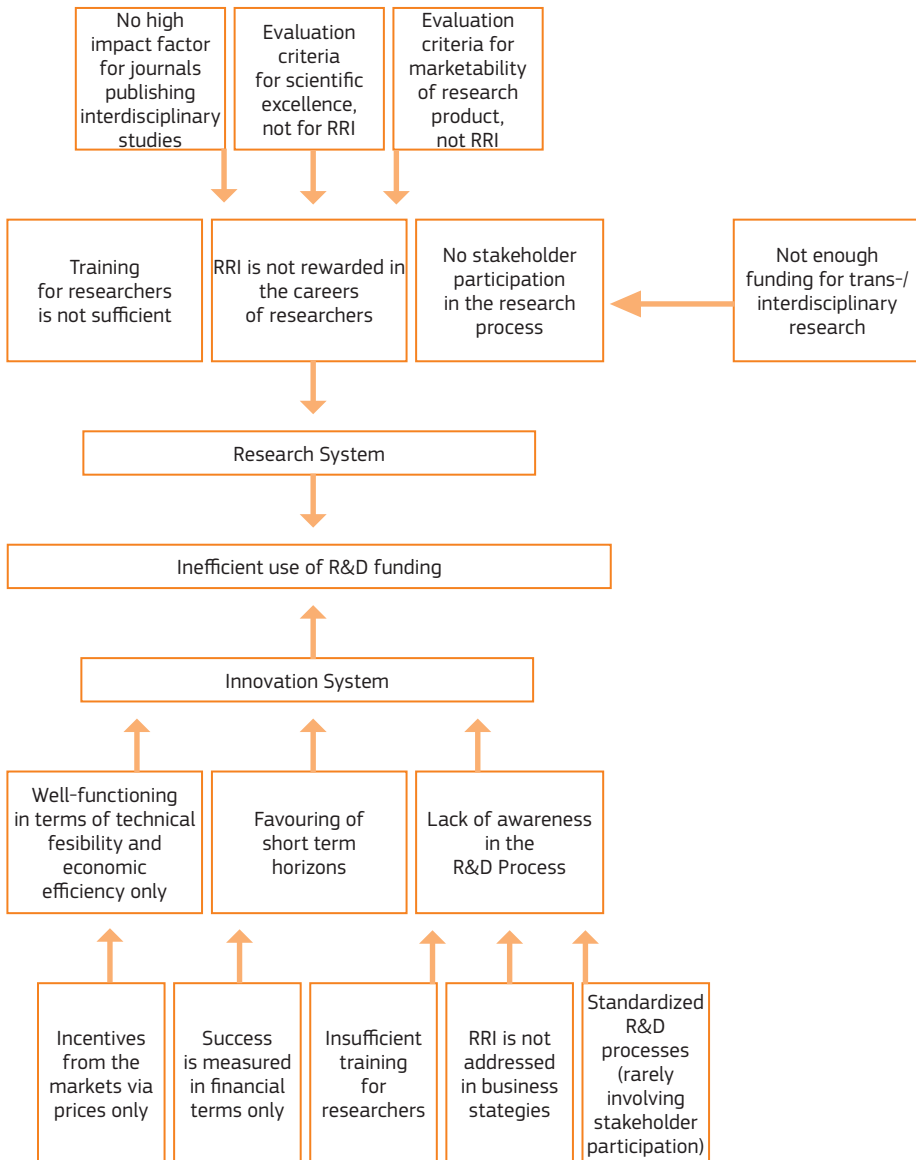
The development of products that serve societal needs or serve the public good is currently not sufficiently attractive for business enterprises. Although many companies have introduced quality and environmental management system, Corporate Social Responsibility (CSR) strategies, and prepare triple bottom-line statements (“People, Planet, Profit”), most companies follow procedures in the research and development process, which do not explicitly take all these dimensions into account, although companies try to integrate sustainability features into their R&D processes. However, the extent to which societal demand or ecological aspects are taken into account vary significantly, often depending on the awareness of individual researchers of those issues, since RRI is not necessarily part of the business strategy. (Clausen et al 2009) So far, there is no coherent approach or guideline on how to integrate aspects of RRI in research and innovation processes.

Similarly, the research system as a whole fails to sufficiently consider such ethical and societal aspects. In the career system of academic researchers, there are hardly any rewards for taking ethics and responsible innovation seriously. There are very few high impact journals that publish interdisciplinary studies; research and academic achievement are evaluated either against criteria of scientific excellence or against the marketability or valorisation of research. Therefore, either scientific excellence or the successful marketing of research results is important to pursue an academic career. Research that aims at solving societal problems is often regarded as less important. This is also reflected in the composition of research funding (Jahn et al 2012). Although many funders, like for example the EU and the German government in their High-Tech Strategies 2020 (Federal Ministry of Education and Research 2010), promote problem-oriented research aimed at solving societal problems in their funding programmes, there is still a gap between the amount of funding needed to conduct truly problem-oriented and trans-disciplinary research with stakeholder participation and the funding provided. Where policies have been implemented, that attempt to increase the value, relevance or impact of research, economic imperatives typically take precedence over broader societal benefit. There are good prospects that the future Horizon 2020 EU Framework Program will address this issue more explicitly.

Policy efforts to increase the societal and economic impact of research have provoked fierce reactions from many European researchers. It is felt that such measures are at odds with the basic idea of scientific research and at odds with their own motivation and the freedom of research. In sum, the conclusion is that the consideration of RRI in designing research is not adequately rewarded in the careers of researchers.

As raised above, the individual researchers are often not aware of the societal and ecologic impacts or the ethical dimension that their research activities might have in the future. (Royal Society 2012) This is also due to the situation that RRI plays – if at all – a minor role in the education and training of researchers. University curricula aim to educate skilled researchers and scientists with an excellent knowledge base in their discipline. Furthermore, as RRI is not rewarded in the careers of researchers, raising awareness for the ethical dimension and societal impacts of research is not emphasized in education and training programs either.

The following graph depicts an overview on the underlying causes that lead to an insufficient consideration of ethical aspects and societal needs in research and innovation:



To overcome these deficiencies, a number of activities take place to foster the application of RRI standards. In Sustainability Science, for example, there are attempts to define criteria for R&D processes that are more problem-oriented and transdisciplinary, take into account societal needs and therefore contribute to developing solutions to the Grand Challenges. However, there are no common quality standards or criteria for transdisciplinary, problem-

oriented research that would guide researchers, program managers or research funding organisations. (Jahn et al. 2012, Kates et al 2000; Komiyama et al 2011) Elements of RRI can also be found in FP7 and other European research funding programs.

The European Commission developed a Code of Conduct Recommendation for Responsible Nanosciences and Nanotechnologies Research. (EC 2008) Also the Responsible Nano Code for business that has been published in 2008 deals with RRI in Nanotechnologies Research and is supported by companies in Europe, the US and Asia. (Royal Society et al 2008) In the Member States, there have also been several further activities on RRI:

- The United Kingdom: Sciencewise, an agency of the Department of Business Innovation and Skills, has commissioned 20 public dialogue projects on issues involving science and technology.
- The United Kingdom: Development of a Code of Conduct for science that resulted in the report “Rigour, Respect and Responsibility - A Universal Ethical Code for Scientists” (DIUS 2012)
- The United Kingdom: Following a large public dialogue exercise on Synthetic Biology, the Engineering and Physical Sciences Research Council has begun developing a framework for responsible innovation that will guide their approach to emerging technologies.
- Germany: Ethics Commission on Safe Energy Supply
- The Netherlands: The Netherlands Responsible Innovation Programme (MVI) is funded by six Dutch government ministries and undertaken by the various departments of the Netherlands Organisation for Scientific Research (NWO), WOTRO Science for Global Development, the Technology Foundation STW, and the Netherlands organisation for health research and development (ZonMw) (Sutcliffe 2008)
- France: Mandatory creation of an ethical committee in Research Laboratories focusing on Nanosciences and nanotechnologies, as a direct result of the national public debate on the nanotechnology governance issues.

Despite these attempts to address RRI, it remains unclear whether these initiatives have already made a difference in the practice of research. So far, there is no coherent definition or common framework for RRI that is applicable across disciplinary lines and among all the Member States, although several tools can be envisaged that fill this gap.

However, there is still no uniform approach and a coherent definition of RRI that can also leads to an ineffective implementation is still missing.

1.6 Affected actors

Because of these failures in the research and innovation systems, the full potential of innovations is not tapped, which affects various actors at different levels. Mainly, four groups of actors can be identified that are affected by these developments:

The first group encompasses research funders who invest in R&D and innovation and business enterprises dealing with innovation. They increasingly recognize the need to promote research and innovation that is targeted at developing solutions for the Grand Challenges. However, there are no coherent criteria for the process and products of research and inno-

vation that include criteria for RRI. Therefore, cases occur when the innovations that follow from current R&D practice might not utilize their full potential to tackle these challenges because a comprehensive understanding of societal needs is missing. This shows that their funds could be more effectively spent by taking into account ethical and societal aspects in the R&D process. These actors include:

- The EC
- National administrations and public agencies
- Business enterprises/ innovative Small and Medium Enterprises/ industry
- Other private research funders

A second category is institutions that carry out research and develop innovation. These are facing a dynamic and global competition, including the competition on providing solutions for the Grand Challenges societies are facing. The consideration of ethical and societal aspects in the research and innovation process can lead to an increased quality of research, more successful products and therefore an increased competitiveness, as well as a higher degree of societal accountability and responsiveness. However, sufficient incentives to integrate society into the research process are still missing. This group of actors includes:

- Universities
- Laboratories
- Industry/ Small and Medium Enterprises that conduct R&D activities
- Other public and private research institutions
- Individual researchers

Thirdly, European citizens are also affected across a range of issues: they require and expect that science and innovation can address challenges like climate change, clean energy, an ageing population or social cohesion to create new jobs and contribute to higher standards of living. However, there are several factors that limit the participation of citizens, stakeholders and civil society groups in the R&D processes of research institutions or businesses:

- Insufficient funding for stakeholder participation
- Research processes not stipulating the inclusion of stakeholders
- Lack of awareness

Finally, legislators and regulators are necessary actors responsible for articulating the societal standards and values for research and innovation, and integrate these in legal and regulatory frameworks. At the same time, coordination of policies (research, innovation, education, taxes, development, other sectoral policies) is essential to effectively translate into coherent governmental action all aspects pertaining to RRI. However, there is currently no coherent transnational approach to RRI among the different actors in this category:

- EU, National and Regional Policy makers
- Ombudsmen and social rights watching organizations
- Regulatory bodies
- Standardisation organisations

1.7 The policy context

The European Union places innovation and research at the heart of its economic strategies. The Europe 2020 strategy lays out the ambition of Europe to grow in a smart, sustainable and inclusive way. This translates into efforts to develop an Innovation Union and the ambition to develop a European Research Area (ERA) by 2014. Innovation and new technologies should meet the global challenges of sustainability such as climate change and global warming, the efficient use of natural resources, demographic change, global health and development, social cohesion and the maintenance of economic prosperity.

The high priority of Research and Innovation is reflected in European and Member States budgets. For example, within the Seventh Framework Programme (FP7) a total budget of €50.5 billion has been made available to fund research activities. (EC 2006) The Competitiveness and Innovation Framework Programme (CIP) offers €3.6 billion to SMEs to support their innovation activities. Furthermore, Education and Training programmes and Structural and Cohesion Funds for regional convergence and competitiveness also aim at supporting the creation of the knowledge-based society and to foster research and innovation within the EU (EC 2011c). Despite the financial crisis, this investment is to be increased: for the period from 2014 to 2020 the EU plans to spend € 79 billion for research and innovation under the Horizon 2020 Programme to further develop the European Research Area. (EC 2011a) Another €2.5 billion will be allocated under the Program for the Competitiveness of Enterprises and SMEs (COSME), which will follow CIP from 2014. (EC 2011d) The budget for the Structural and Cohesion Funds is not yet decided, but current proposals indicate that a considerable portion of this can be expected to be invested in innovation.

This public investment underpins substantial private sector R&D across member states. According to Eurostat estimates the total Gross Domestic Expenditure on Research and Development (GERD) of the EU 27 increased from €179 billion in 2001 to €245 billion in 2010. Looking at the different sectors of research funding, the amount of funding available has increased in all sectors. In 2001, the total BERD (Business Enterprise Research and Development) of EU 27 countries has been €116 billion. In 2010 business enterprises spend 151 billion. The GovERD (Government Research and Development) of the EU 27 has increased from €23,5 billion to €30,5 billion in the same period. In the sector of higher education, funds have raised from €38,5 billion to €55 billion. Also, the private non-profit-sector increased its activities from 2001 to 2010. Starting with €1,3 billion in 2001, funding from organizations in the private non-profit sector has increased to €2,3 billion. (Eurostat 2012)

1.8 The need for EU intervention

Giving ethical concerns and societal needs a greater role in research and innovation requires policy action in order to ensure a concerted human-centric and politically supported European action. Market failures within innovation systems mean that consideration of ethical aspects and societal needs in R&D activities is not adequately rewarded, so markets alone will not be a sufficient driver to promote RRI. However, the development of an Innovation Union and a Single Market for innovative technologies requires the development of Euro-

pean policy guidelines and standards which can be applied everywhere in the Union and which reduces the risk for innovators to be faced with ever changing requirements for their technologies. The development of such guidelines and standards present the opportunity for Europe to set global standards for Responsible Research and Innovation which necessarily entails global markets. Finally, there is a need for action in order to safeguard the efficient and effective use of the publicly funded investments undertaken in research and the development of innovative technologies.

There are already efforts in some of the Member States to develop frameworks for RRI. So there is a need for coordination of these activities to share experiences, avoid duplication, and harmonize standards for RRI among the Member States. This is needed to avoid confusion of different definitions and criteria, because only common standards for RRI, fully compliant to European values, can contribute to the free flow of knowledge and open innovation within the EU.

Member States acting alone would benefit from taking a head start, but would not be able to create a framework that is coherent within the EU. That is why action on the European level is necessary, in order to ensure coordination, common standards and the removal of cross-border barriers to cooperation for private and public actors.

2 Defining the objectives

The overall objective of action on EU level is to facilitate and improve the consideration of ethical concerns and societal needs in research and in innovation undertaken in Europe, with a view to the achievement of the EU2020 objectives and the development of the ERA. This should contribute to a more efficient use of the public funding for Research and Innovation as this has been identified as the main failure resulting from an insufficient application of RRI. Moreover, it should better gear Research and Innovation to fulfil societal needs, guarantee systematic and consistent expression in R&D of the EU fundamental values as codified in the European treaties on Human Rights and the EU Charter of Fundamental Rights to improve competitiveness on the world's emerging markets for responsible innovation. Finally, action on the European level should contribute to a free flow of research and innovation within Europe, thereby contributing to the development of an Innovation Union.

In sum, an improved consideration of RRI can contribute in at least three dimensions:

1. The normative dimension: RRI can contribute to anchoring research and innovation in European values that have been laid down in e.g. The Treaty of the European Union and Charter of Fundamental Rights of the European Union.
2. The substantive dimension: RRI can help making decisions substantially better, because it adds a focus on societal needs and ethical aspects to the process which will eventually lead to a more sustainable outcome that reflects societal demands and provides for long term developments. RRI can, therefore, help delivering the targets set out in the Europe 2020 strategy of developing an economy that is smart, sustainable and inclusive.
3. The instrumental dimension: The consideration of RRI can improve the situation of administrations as it contributes to making research and research funding more effective, leading to more problem-oriented outcomes

More specifically, the objective of EU action should be to develop, within the ERA framework, a coherent approach among the EU Member States that defines processes, instruments and criteria for RRI that encourage researchers and innovative firms to consider ethical concerns and address societal needs.

A framework for the operationalization of RRI entails the following aspects:

- Defining criteria for RRI

To guarantee that the intensified application of RRI contributes to the free flow of research and innovation in Europe, it is necessary that a common understanding of RRI is developed among the member States. Therefore, a Communication or Recommendation from the European Commission should initialize a dialogue on the different approaches towards RRI leading to the development of a shared definition of RRI including the definition of criteria.

- Defining processes for a successful application of RRI

To enhance the application of RRI in Research and Innovation processes, it is beneficial to define processes how RRI can be applied successfully. A Communication or Recommendation should initialize the development of standards and norms for research institutions and business enterprises that can be applied systematically in Europe.

- Defining instruments to encourage RRI

A Communication or Recommendation should suggest instruments that can be used to enable the application of RRI and that provide incentives for this.

3 Developing main policy options

3.1 Policy options

In the problem definition, several factors have been identified that constrain the application of principles of RRI in research and innovation systems and therefore limit their effectiveness of funding spent for research and innovation.

It has been pointed out that both in the research system and in the innovation system, there are systemic constraints on the consideration of societal needs and ethical aspects. Therefore, it is necessary to provide stronger incentives to apply RRI. However, these options should be seen as a starting point for facilitating the debate on RRI. They should initiate a process towards a common framework for RRI rather than giving detailed criteria on how to design such a framework. To gain acceptance and support for the initiative it is essential that all affected actor groups participate in the practical conceptualization of the measures.

In this section, several policy options will be discussed that refer to the constraints in the research and innovation system and provide opportunities to enhance the application of RRI criteria in R&D processes.

However, it is important to note that these options are designed to foster the debate on RRI in the Member States and to help developing a framework for RRI activities of the affected actor groups that have been identified in the Problem Definition rather than suggesting fixed criteria to be applied in all Member States.

Therefore, most of the suggested options offer the opportunity to change the background conditions for RRI that facilitates the application of RRI in R&D processes. Hence, the options are not specifically targeted at only one of the causes identified in the problem definition, but are aimed at establishing a framework for RRI activities that enables decision makers in policy making, business enterprises, research and society to change the conditions that now constrain a stronger role of RRI in research and innovation.

3.2 Option 1: Business as usual (BAU)

The assessment of the business-as usual option is in accordance with the Commission's Impact Assessment Guidelines, which specify that a baseline scenario should be developed that includes a "no policy change" option.

In this scenario, the existing approaches to address RRI in the EU funding programmes and their evaluation criteria would continue to be the main tools to promote RRI at the EU level. There would neither be any additional efforts to address RRI in the upcoming funding programmes like Horizon 2020 nor any new funding opportunities to address RRI.

Moreover, because of the financial crisis and subsequent recession, research budgets are under pressure in many Member States. This is very likely to threaten existing funding for RRI activities, in line with research funding cuts or perhaps disproportionately if RRI is misconstrued as impeding short term economic growth.

Furthermore, several Member States and potentially also private business would continue to develop specific approaches to RRI. Such approaches include standards for specific technologies (e.g. Nano), issue areas (e.g. Sustainability Research) or sectors, e.g. pharmaceutical industry. However, there would neither be any attempts to coordinate the different approaches towards RRI that are currently developed in the Member States within a strategic framework nor an attempt to initiate a process for the development of a common European understanding of RRI. The standards for RRI would remain scattered. Whereas the danger of fragmented inconsistent standards in the Member States might be driven by national regulatory bodies and policies, industry is driving more and more towards international standards, like for example Corporate Social Responsibility (ISO 26000), which is supported by agreements of the European and international standardisation organisations to coordinate their activities. These internationally harmonised activities bear not the threat of fragmentation, but might contradict the interests of the European Union and its Member States. For example, in the area of nanotechnology stakeholders from the United States of America, but also Asia have slightly different preferences in the area of nanotechnology standards than European representatives. However, the publication of international standards has also implications for European standards, due to the general rule of adopting international standards in the set of European standards.

Potentially, there would be a sharing between different RRI approaches leading to improved governance. However there is so far no broad empirical evidence for such convergence, e.g. related European or international standards.

3.3 Option 2: Improved BAU: Funding for RRI

3.3.1 Action a: Mainstreaming of RRI in the EU's funding programmes

This option is targeted mainly at raising awareness for RRI. Lacking awareness has been identified in the problem definition as one of the constraints for the application of RRI. Moreover, it aims at setting an incentive for researchers to consider aspects of RRI in their work with the target to add another dimension to the current evaluation criteria of scientific excellence and success as well as providing for transparency over the consideration of RRI aspects in research and innovation.

As identified in the first Chapter, RRI is not rewarded in the careers of researchers, partly because scientific excellence is one of the main criteria for evaluating research. A stronger emphasis on RRI in the evaluation of research and research proposals can be an incentive for researchers to explicitly take societal needs into account.

One way to promote RRI is to mainstream RRI in the existing funding programmes. In this case no new funding opportunities on RRI would be allocated, but criteria for RRI would have

to be applied across all EU funding programmes. This would not only raise awareness for RRI but also create greater transparency with regard to the provisions for taking into account societal needs and ethical aspects in the proposed research.

One option would be to restructure the evaluation process of research proposals responding to calls from the EU's funding programmes. In this scenario, the EC develops criteria and principles for the EU's funding schemes putting a stronger emphasis on the application of criteria for RRI and orientation towards Grand Challenges.

There are several options for implementing this:

- Applicants for EU research funds have to submit a statement on the ethical aspects of their research already. This could be emphasized and applied more broadly. Additional guidance could be offered to applicants on the completion of this section.
- Asking for a statement in each research proposal on how the research might contribute to addressing societal challenges (similar to the outline on the consideration of the Gender dimension)
- The potential contributions to societal needs and the consideration of ethical aspects could become part of the selection criteria for research projects. So far, proposals are assessed against 1) scientific excellence, 2) potential impacts (broadly defined) and 3) management of the project. RRI aspects could be considered as a fourth aspect or a specification of the potential impacts.

Another way of mainstreaming RRI in the EU funding programmes is to include requirements for the consideration of RRI into research funding for training activities, for example the Marie Curie actions. This approach would address the cause identified in the problem definition that researchers involved in the research or innovation process are trained sufficiently regarding ethical aspects and potential unintended impacts of their research in society.

Also, this increased attention for RRI in the evaluation of research would contribute to raising awareness for societal and ethical concerns not only among researchers, but also more generally among policy makers and stakeholders involved in research and innovation.

3.3.2 Action b: Increased share of funding for trans-/interdisciplinary research

An increased share of funding for inter- and transdisciplinary research including funding options for stakeholder participation in the research process is another way to further encourage research that takes into account societal needs more directly.

As it was identified in the problem definition, limited stakeholder participation is one of the causes leading to an inefficient use of R&D funding, because by excluding societal actors from the R&D process their needs and demands cannot adequately be taken into account. Therefore, this option is mainly directed at extending the participation of stakeholders, e.g.

representatives of consumer, environmental and other ethically oriented organisations, in R&D and innovation processes in business enterprises and public research¹.

In Horizon 2020, public engagement and stakeholder participation can be enhanced via 'upstream' engagement in the definition of research and innovation Work Programmes. A transparent methodology, including indicators for monitoring impacts, would have to be developed to facilitate such upstream engagement. Due attention has to be paid to diversity and representativeness in such participation.

Furthermore, on the level of individual research projects funded under Horizon 2020, public engagement can be encouraged via making this a compulsory part of project activities, expanding on the 'dissemination activities' that are currently requested to projects. In addition, more use can be made of new funding instruments developed under FP7, such as the BSG-CSO (Research for the Benefit of Specific Groups – Civil Society Organisations) and MMLAP (Mobilisation and Mutual Learning Action Plans) funding instruments.

An increased share of funding for research that provides for participation of different disciplines in the research process can ensure that the object of research is analyzed from different perspectives. In this way, it is more likely that a comprehensive understanding of the impacts on society also regarding unintended consequences will be developed.

In this context, one option is linking research projects with standardisation activities, because national and European standardisation bodies provide the platform for the involvement of all interested stakeholders to participate in the development of standards, which reflect not only the interests of industry and research, but also representatives of societal interests, e.g. related to health, safety and environmental issues. Consequently, the results of research projects can be invaluable to standardizers. However, research activities and projects need to acknowledge the state-of-the-art information on standards that are available or that are under development (Blind and Gauch 2009). In some cases, the standards activity itself may generate the need for additional research, for instance into the appropriate test methods for a product. Therefore, the research activities under Option 2b can be connected with the coordination or more specifically the standardisation activities envisaged under Option 3 to generate synergies toward RRI both in research and coordination activities².

3.3.3 Action c: A specific funding line for research on RRI

Although research on RRI has been funded under the FP7 science in society programme, there is still a need for more information on the interactions of science, innovation and

1 One of the recommendations of the Lead Market Initiative (Centre for Strategy & Evaluation Services and Oxford Research 2011) is that the promotion of end-user interaction with research - from the shaping of objectives to the detail of the work undertaken and its subsequent application - is a major advantage of the lead market approach, providing positive links between the demand-side and supply-side, which should be exploited further.

2 A dedicated joint working group on Standardization, Innovation and Research, (STAIR), has been created to provide strategic advice to the CEN and CENELEC Technical Boards on synchronizing standardization with innovation and research. The CEN and CENELEC Technical Boards have endorsed the STAIR view that standardization has to be considered during all stages of a research or innovation project, the so called Integrated Approach.

society. Moreover, the academic debate on RRI is currently evolving dynamically. So there is a need for exchange among the researchers, further development of the theoretical approaches and the study of conditions for a successful application of RRI in practice. Research could contribute by observing, comparing and analysing different standards in the EU, Member States and beyond. Furthermore, a new set of standards could be developed. However, it is important to link the research on RRI to other research areas to avoid RRI becoming an academic field separated from applied science.

In relation to the Problem definition, this option contributes to gain a better understanding of the underlying causes for the limited application of RRI, to raise awareness for the topic and to create framework conditions to develop concepts how to counteract the systemic challenges for RRI.

3.4 Option 3: Improved coordination with the Member States without a legally binding initiative

Option 3 lists several actions that can contribute to an improved coordination among the Member States. These actions suggest ways how to develop a framework and criteria rather than imposing substantive, pre-defined criteria for RRI that might not meet the requirements and preconditions of each of the involved actors. Therefore, this option is process-oriented, aiming at fostering the dialogue on RRI enhancement and improving the transparency with regard to RRI activities in the Member States.

The option of improving the coordination among the Member States goes beyond strengthening RRI in the existing funding programmes of the EU. This option includes directly addressing the Member States as well as business enterprises, research institutions and public and private research funders. However, option 3 and option 2 are not mutually exclusive, but can be used as complementary tools to promote RRI.

Hence, this option is not targeted at only one of the root causes for the limited application of RRI in research and innovation, but creates a framework enabling policy makers, researchers and business enterprises to put a stronger emphasis on RRI by raising awareness for the issue, but also by changing education and setting incentives for applying RRI in both research and innovation.

It is also important to note this improved coordination would not be due to legally binding initiatives, but would rather follow the open method of coordination. Therefore, guidelines would be developed to establish a benchmarking process for RRI among the Member States.

These guidelines can be developed for several areas depending on which of the failures identified in the problem definition should be addressed.

Therefore, the Member States should develop an understanding of RRI that serves their requirements. In several of the Member States there are already debates on this topic and criteria and approaches are currently being developed. In others this process still has to be

initialized. In any case it will be crucial to ensure participation from as many actor groups in the process as possible, in order to gain support among the various affected communities.

However, as was pointed out in the problem definition, there is a need for coordination at an EU level to ensure that approaches are developed that are coherent and do not constrain international cooperation in research, development and innovation. There are different ways of making sure such a coherent framework will be developed. One of them is the enhancement of transparency regarding RRI and fostering collaboration among the Member States regarding this topic.

This option offers the opportunity of coordinating existing approaches towards RRI and fostering inter-governmental cooperation in this field, which strengthens the coherence and integration of European policies that impact on RRI. This can be operationalized by introducing a checklist for the Member States in which they can report on their RRI activities based on their own definitions and approaches towards RRI.

3.4.1 Action a: Improved Coordination of RRI activities in the MS

This framework for enhancing the cooperation of RRI activities among the Member States can be accompanied with a reporting scheme on RRI activities. As mentioned in the Problem Definition, there is a voluntary reporting scheme for engineered nanoscale products. A similar scheme can be set up at a broader scale covering RRI activities in general.

This would first, improve the coordination among the Member States and enable them to identify examples of good practice. It can also be used to set benchmarks.

This can conclude in a regular report of the Member States to the EC.

In the report as it is suggested here, it is the task of each Member State to define their approach towards RRI and highlight the respective targets and focal points of the RRI activities. Based on this definition, that matches the requirements of the Member State, the checklist for the report to the EC can be adopted accordingly.

Questions that could be addressed in the checklist are:

- What is the focus of RRI in the respective Member State?
- Existence of a focal point for government accountability on RRI
- Existence of a national public policy on RRI
 - objectives
 - principles (including ethics, gender, open access, education, essential values like dignity, privacy, justice, security, sustainability etc.)
 - guidelines on reporting/compliance schemes
 - standards
 - roadmap towards RRI with intermediate goals
 - assessment indicators

- Existence of European/ international cooperation
- Existence of foresight processes
 - dissemination of guidelines and principles
 - do's and don'ts (rules to comply with)
 - good practices
- Provisions for transparency of RRI activities
- Existence of inspiring/reporting schemes towards entities/teams/individuals according to the levels of responsibility
- Existence of curricula and certification for education/training
- Existence of research and publication on the topics
- Studies on benchmark publicly available publicly (failures, success stories)
- Availability of relevant documentation for all stakeholders (investors and shareholders, managers, consumers, citizens, suppliers, wage earners, patients, media, teachers, researchers, incubators, public authorities, etc.)
- Existence of a deliberative process for the assessment of the inspiring/ reporting scheme
- Existence of funding schemes especially on RRI
- Existence of funding schemes that include RRI
- Existence of incentives for business enterprises for RRI (e.g. pre-commercial procurement initiatives for RRI, promotion of ethical funds)
- Consideration of RRI in education and training

To enhance cooperation among the MS in this field, the EC can initiate a dialogue among the Member States through organizing conferences, workshops, etc. on the topic, or fund a dedicated action via Horizon 2020 (for example via the CSA funding scheme). These activities can be complemented by a database with documents and information on:

- Overview on the approaches in the MS (principles, guidelines, standards, etc.)
- Summary of the Reports to the EC
- Examples of good practices

Such a reporting scheme would address the Member States to initialize or further develop a debate on RRI, its criteria and aims as well as its evaluation within each Member State. In the first place, a reporting scheme would therefore raise awareness for the topic and provide a strong incentive for the Member States to bring forward the discussion on RRI.

Especially, the following activities can be envisaged by the Member States to enhance RRI. These actions will address some of the barriers that have been identified in the problem definition.

3.4.1.1 Funding activities for RRI

As it was shown in policy option 2, there are several options for strengthening RRI using research funding as an instrument. Although the EU invests a considerable amount in research funding, the Member States and especially business enterprises invest a substantially larger amount. However, the measures suggested in option 3 do not address public research funding in the Member States or private funding.

Therefore, one way of promoting RRI is to establish funding schemes for RRI within existing Member States funding programmes. This could include funding for research on RRI and including RRI criteria in the eligibility criteria for research funding. The Member States in cooperation with the Commission could develop guidelines that provide instructions on how to design such a funding scheme. These guidelines would raise awareness for the topic. Indirectly, they will also have positive effects on the incentives for the application of RRI criteria in R&D processes. These incentives will increase with the number of Member States adopting the guidelines. A structured strategic process could be initialized whereby Member States agree common visions and strategic research agendas on RRI.

The instrument of joint programming could be used for this purpose. The existing and proposed Joint Programming Initiatives (JPIs) should pool national research resources to deal with various societal challenges. A new JPI could be proposed that addresses RRI. As RRI is not yet well established in national research funding programmes, initial 'pilot-phase' support via EC funding, for example via the ERA-NET funding scheme available under Horizon 2020, may be envisaged. Such a phase should prepare the ground for an ensuing JPI.

A further example of where RRI can be implemented concretely via Community action in partnership with the Member States, specifically focussing on innovation, is given by the European Innovation Partnerships (EIP). These partnerships are explicitly focused on addressing societal challenges and, in so doing, enhancing Europe's competitiveness. The concept provides for a strategic approach to innovation which has its origins in the Europe 2020 strategy. It is important that RRI is an integral part of the EIP strategy.

3.4.1.2 Setting Incentives for RRI

Another way of stimulating RRI in private research and innovation conducted by business enterprises is to set incentives. In the Problem Definition it has been shown that the most important incentive for investing in innovation is expectation of receiving economic returns, e.g. by achieving higher prices or larger market shares. To add another dimension the Member States can stimulate RRI in innovation processes by using Public Procurement to start pre-commercial projects and to purchase innovative and e.g. sustainable products as a policy instrument (see OECD 2011)).

In a communication from the Commission (COM (2007)799 final) the Commission provides guidance on how EU rules on public procurement can stimulate innovation by addressing the issue of pre-commercial procurement which is targeted at the R&D process before the commercialization of a product.

The EU and Member States have developed important initiatives to use the enormous leverage of public procurement for guiding companies, particularly SMEs, towards greater innovation. In Spain, for example, the Government has committed to use 3% of the total budget of the Central Administration (i.e. more than 3 Billion €) in pre-commercial projects and for the development of innovative products by 2013. Besides, Hungary and Belgium launched pre-commercial procurement initiatives. The EU's Horizon 2020 proposal also includes Public Procurement as a specific tool to foster innovation among the European companies. These initiatives that use public budgets to foster companies' innovation capabilities, have a large potential for introducing, expanding and consolidating RRI methods and standards in the private sector.

In particular, the following actions could be envisaged:

- Identification of potential areas for public procurement and SBIR (Small Business Innovation Research) projects in themes relevant to RRI
- Possible use of the H2020 Public Procurement initiatives and SME dedicated instruments such as SBIR for promoting RRI projects in Europe
- Guidelines for EU and MS on the use of Public Procurement and SBIR for promoting RRI initiatives through their respective budgets, including regional ones.

3.4.1.3 Training activities

As identified in the problem definition, insufficient training of the individual researchers is another reason why RRI is not considered more extensively in research and innovation processes. Therefore, it is necessary to address education and training to make the consideration of ethical aspects or societal needs an integral part of their work. This would ensure that researchers are better equipped to anticipate ethical concerns and to consider them in the future R&D process. Moreover, they will be better able to deal with unintended side effects of their projects.

Although, it is the task of the universities to develop curricula and to decide which subjects these should encompass, a strategy or guidelines on how to include education on RRI would raise their awareness for the topic and provide assistance for integrating RRI in study programmes. Some universities integrated compulsory courses on the ethical aspects of the subjects of their study programmes already, but many others lack such courses. To ensure coherence of this strategy development processes among the member states, the EC, in collaboration with Member States, could support the strategy development process by initiating workshops and conferences to raise awareness, share experiences and identify common goals.

3.4.2 Action b: Codes of Conduct for RRI activities (national or disciplinary initiatives)

Codes of conduct are a method of self-governance by which researchers and innovators can agree on norms or standards. They can operate at different levels, applying within particular

areas or across wider fields of activity. They are beneficial, both because of the collective process of reflection involved in drawing them up and as reference points for RRI discussions. In the UK, a recent initiative to develop a code of conduct for science has resulted in a document called Rigour, Respect and Responsibility (www.berr.gov.uk/files/file41318.pdf). Codes of conduct in areas such as nanotechnology have already been considered at the European level.

The EU could oversee the process of a more general code of conduct, and it could also coordinate additional activities across the Member States, in different areas of R&D and innovation.

3.4.3 Action c: Standards on RRI that can be adopted voluntarily

Next to enhancing the dialogue on RRI in universities, research institutions and business enterprises in the Member States to develop common codes of conducts for RRI, there is also the option to develop a common framework for RRI that is applicable for the design of research processes in business enterprises that can be adopted voluntarily.

In this scenario, a dialogue would be initiated to develop a common framework for RRI activities by proposing a harmonized approach towards RRI that can take the shape of European standards.

To avoid fragmented approaches in the Member States that are incompatible with each other and therefore hinder the development of RRI in the European Research Areas and the Single Market for products and services, European RRI standards should be developed. These standards may then be leveraged on the international level, to achieve impacts on the global level. In this scenario, the European Commission, the Member States, business enterprises, research institutions and societal stakeholders will be coordinated by the European standardisation body CEN in a first stage, and might then collaborate with international standardisation bodies, like ISO, to ensure that (global) standards are developed that address research and innovation processes.

This policy option mainly aims to start a process on the European level to develop a common understanding of RRI. This process can be organised in a similar way to the formulation of the ISO norm 26000 which provides guidance on CSR practice in business enterprises and other organizations. The aim, which could be supported by a standardisation request, a so called mandate from the European Commission to the European Standardisation Organizations (ESOs) (http://ec.europa.eu/enterprise/policies/european-standards/standardisation-requests/index_en.htm), would be to develop a similar process standard that can serve as a guideline for business enterprises and research institutions to organize their research and innovation processes accordingly. The development of this ISO standard involved extensive stakeholder participation, harmonising the different approaches towards the concept.

This new standard could define a research process that complies with principles of RRI. Consequently, a management process for research would be established that can serve as a framework for RRI activities in business enterprises and could consist of standards for R&D processes and process management. The envisaged standard could be coordinated with the future deliverables of CEN/TC 389 on Innovation Management created in 2008 to

support a culture of innovation in Europe and accelerate the access of innovation to both domestic and global markets.

These standards could include the following aspects:

- A shared definition of RRI, including principles like orientation towards solutions for the Grand Challenges, gender equality, open access, public engagement etc.
- Common standards/ criteria for RRI to define a high quality research process regarding RRI
- Common assessment indicators
- Raising awareness in other policy areas (cooperation, labour, agriculture, fisheries, public works, defence, health, education...) to extend the potential of RRI in solving their requirements of advanced public services.

These standards could be complemented by transparency criteria for investment management.

Developing a framework for RRI would firstly require a dialogue process that brings together all relevant actors that are currently involved with shaping the debate on RRI. These include the Member States themselves but also other stakeholders like research institutions, businesses and societal actors. This would also include developing a roadmap towards RRI including the definition of intermediate goals that can serve as reference points for establishing a specific standard on RRI management.

The organization of conferences and workshops on the topic that bring together all involved stakeholders from governments, businesses and society can be a useful starting point to initiate a dialogue on a common framework for RRI.

This standard directly addresses all organisations conducting research, development and innovation, e.g. business enterprises, but also provides society represented by research funding organisations with indicators to benchmark RRI activities of their funded institutions, e.g. business enterprises and research institutions. In this way, a standard on the ethical or societal dimension of research processes contributes to raising awareness for the issue and provides society with indicators to enable them to take part in the discussion on RRI more actively.

Moreover, a standard on RRI in research and innovation processes can be used as a reference framework for a benchmarking system for RRI in a way proposed in option 3a. Furthermore, such a standard could be used as a basis for a certification scheme, like in the case of other management standards, like the ISO 14000 series of environmental standards.

3.5 Option 4: Improved coordination with the MS with a legally binding initiative

The fourth option is to develop a binding initiative that has to be implemented in the Member States.

Under Option 3 several options have been introduced that can enhance RRI through different means and at various levels. However, these options envisage primarily guidelines on how to address the issue or voluntary agreements to promote RRI.

But there is also the option to make their implementation mandatory via European regulations and directives. Hence, option 3a to 3c can be transferred to option 4 with the difference that in this scenario, the EU would adopt a more top-down approach to promote activities on RRI by making the suggested initiatives binding.

For example, the mandate of the EC to developed RRI related standards could lead to European standards, which could complement European regulations and directives.

4 Analyzing the impacts of the options

In order to make choices regarding the 4 options developed in chapter 3, it is necessary to compare their impacts. This is difficult as some of the options are designed to initiate or enhance development processes for RRI activities rather than suggesting concrete measures, but some elements can be pointed out. The impact assessment includes analytical steps, criteria for comparisons and impacts for different groups of actors.

It must also be taken into consideration that the impact of the options will be to start an important process, which includes an introduction of a new dimension in research and innovation. A similar situation arose, when ethics was introduced 20-25 years ago and the experience from this process has been positive. The EU has in many ways been a frontrunner, for example in establishing the EGE (European Group on Ethics in Sciences and New Technologies) that advises the European Commission. Interdisciplinary research and research on the challenges from global change (including environmental, social and economic changes resulting from globalization, e.g.) can serve as example and reference: While this research is now well established not only in Europe and its Member States but also worldwide, the establishment of such research agendas, communities, theories and methods took time. Similar, the integration of Ethics and Responsibility will be a process.

Thus the impacts will not necessarily show immediately at full scale, but will develop over time. The example of interdisciplinary and global change research also demonstrates that the establishment of new dimensions in research is not easily straightforward, but that it has to be fitted in and – at least to a certain degree – competes with the existing structures in research and funding. In this respect it may be of great importance for the EU to be a “first mover” in the field. Europe has the opportunity to develop technical and social innovation which serves to meet the Grand Challenges. Many of these are important for Europe as well as for the developing countries and taking up these challenges is essential.

The options presented have different impacts both when it comes to benefits and costs. At this early stage it is important to focus primarily on the costs as they will appear immediately and are easier to measure than the benefits. This does not mean, however, that the benefits will not be essential, but the estimate on these is much more difficult and thus has to be accepted as more implicit - but yet as extremely important. Even if the goal is to influence both research and innovation some of the options are geared to the governance of research, as governmental actors have more opportunities to influence these directly, while impacts on innovation in private companies are secondary to this or rather a result of framework conditions. Nevertheless, options that are at this stage restricted to research in a narrower sense, can be expected to influence research as well as innovation.

It is in many ways difficult to be very precise when the impacts of the different options are analysed. Nevertheless it is important to try to develop some tools to help making the impacts

explicit and to a certain degree measurable. Even if this implies many uncertainties it will help broadening the perspectives and including more “soft” and societal and human consequences, which are seen as essential and supplement the economic impacts. This way Responsible Research and Innovation is introduced in a specific manner that can be handled in practice. To this end the scope, costs, actors and funding agencies are included in the impact analysis.

4.1 Option 1: Business as usual

The impacts of the “business as usual” option have been demonstrated in the first chapter: Currently, there is a lack of incentives for RRI in R&D processes and innovation as RRI is neither rewarded in the careers of researchers nor does the consideration of societal needs and ethical aspects translate into prices immediately, which have been identified as the strongest market incentive for innovations. Moreover, there is a lack of awareness among the researchers for issues regarding RRI. If no measures are taken to promote RRI, this would mean that no additional costs will directly emerge for business enterprises and research institutions or for research funders or societal organizations.

However, this would imply that the potential of research funding is still not fully exploited. Indirectly, this leads to costs for business enterprises and research institutions that could have developed more successful products, for research funders who could have spent their funding more efficiently and for consumers who do not necessarily receive products that serve their interests in the best possible way. However, as it has been pointed out in the first chapter, it is hardly possible to quantify the costs for failed innovation or the costs that result from researchers not paying attention to unattended fields in the long run.

Yet, the business as usual option does not mean, that there will not be any initiatives promoting RRI in the Member States. To the contrary, there are currently initiatives in some of the Member States to develop approaches towards RRI. Without an effort to at least coordinate these discussions, the European landscape on RRI will be fragmented which in turn can be counterproductive for the Innovation Union and the Single Market. The EU and the Member States would not be able to make the best use of their resources as an unsatisfactory level of coordination will continue to exist which potentially leads to many inefficiencies as for example duplication of work and sub-optimal policies.

A harmonization of the different approaches on RRI at a later stage, when most Member States already developed their own strategies, will be more costly for all involved actors than initiating a coordinated approach on RRI in the beginning of the development process.

4.2 Option 2: Improved BAU: Funding for RRI

The actions suggested in option 2 mainly address the EU's research funding programs and point out ways how to enhance RRI through changes in these programmes.

The actions suggested under Option 2 would apply to research funding allocated by the EU which will add up to €79 billion under the Horizon 2020 programme and another

€ 2,5 billion under the COSME programme. Additionally, there will be also funding for innovation from the Structural and Cohesion Funds. Research institutions and business enterprises applying for funding under these funding programmes would also be indirectly affected as their research processes would have to conform to the eligibility criteria of the EU funding programmes.

These options would not address changes in the research funding from the Member States, business enterprises or other private research funders. However, the EU can serve as a role model possibly leading to spill over effects in the Member States funding activities.

This action directly affects the EU as research funding body and all public and private research institutions that apply for funding from these funding programmes. Other research funders or research institutions will not be addressed directly. However, as mentioned above, spill over effects are possible.

A more detailed description on the impacts of the different actions will follow below.

4.2.1 Action 2a: Mainstreaming of RRI in the EU's funding programmes

This option will ask researchers to reflect on the ethical questions and questions of social needs, if any, associated with their work, and researchers' responsibilities to consider and respond to them. It is therefore likely, at the margins, to prompt more nuanced research proposals and lead to new disciplinary connections.

This would require revising the statement on ethical aspects of a research proposal and expanding its criteria. Furthermore, researchers can be encouraged to include stakeholder participation in the setup of the proposal or in the project, e.g. in form of advisory bodies.

The administrative burden resulting from this action is regarded as rather low for the researchers applying for funding. They have to give a statement in the ethics review for each research proposal in any case. A revised proposal that would probably include some more criteria would not increase the effort to fill in this statement significantly. Also the review process would not become significantly more complex. Therefore, also the costs resulting from this change in the application process would not raise significantly for the reviewers.

Yet, the transparency of current research practices and the approaches to include societal needs in research and innovation processes would not be increased significantly either. Therefore, civil society organizations will not be enabled to demand for a stronger involvement in the discussion on RRI through this measure.

As this measure is affecting only a limited number of actors directly, the impacts on the innovation capacity of the EU will be limited as well as the contribution to EU's policies. The research commissioned by the EU will become more problem-oriented and focused on the Grand Challenges. However, the capacities for achieving major progress are limited.

Also, the harmonization capacity is rather low, as this action does not provide a strong incentive for the Member States to adapt their research funding programmes accordingly, although spill over effects are possible.

4.2.2 Action 2b: increased share of funding for trans-/ interdisciplinary research

4.2.2.1 First Order Impacts

As action 2a, this option is also targeted at research funding provided by the EU. However, only a share of the funding resources could be used for trans-/ interdisciplinary research. Therefore, even a smaller amount of resources would be affected by this action.

Again as for action 2a, spill-over effects in the Member States are possible, which would increase the amount of mobilized resources and broaden the range of affected actors. However, the reach of this action would be rather limited.

On the other hand, more inter- and trans-disciplinary research should nurture greater innovation and creativity. It should also force more rapid consideration of ethical questions and social needs and would therefore positively affect the innovation capacity of the EU.

Moreover, transdisciplinary research puts a stronger emphasis on the inclusion of stakeholders in the research process. A greater share of funding for these activities would enable researchers to organize stakeholder consultations without having to raise additional funding for these activities. The early inclusion of stakeholders makes it more likely that research and innovation are more directly targeted at solving the 'Grand Challenges'. This possibility also reduces the risk of costs that result from products that are not successful on the market because they do not respond to society's demand.

Costs that arise from this measure are also rather limited as business enterprises and research institutions get the chance to cover additional costs arising from including other disciplines or stakeholders in the research process through the increased share of funding for transdisciplinary research if this funding scheme also allocates funding for including stakeholders in the research process.

The Horizon 2020 proposal offers greater flexibility and more options to propose research in interdisciplinary fields and defining priorities based on societal challenges than the former funding programs and therefore should contribute to also promoting RRI.

However, the harmonization capacity of this option is very low as it does not address research funding in the Member States and is limited to a small amount of funding on the EU level only. Nevertheless, the successful implementation of such an approach on the European level might create "spill-overs" to the funding practices in the Member States.

4.2.2.2 Second Order Impacts

This option can increase trust in research and innovation and their results or products as it provides for the opportunity of including stakeholders and to consider problems from a holistic perspective by integrating various disciplines in the research and innovation process.

Changes in the mind sets of researchers can also be achieved through implementing this option as the integrated approach in research and innovation can gradually enforce the consideration of ethics and societal responsibility.

However, the impact of this action is limited in so far as only participants in these funding schemes would have to deal with trans- or interdisciplinary approaches in research and innovation processes. Researchers and innovators not participating in these programs would not be affected.

4.2.3 Action 2c: a specific funding line for research on RRI

Improved understanding of the conceptual basis of RRI and its implementation will improve science policymaking and can stimulate the debate on RRI.

4.2.3.1 First Order Impacts

As the Horizon 2020 programme distinguishes itself by being flexible as to the areas of research and innovation it aims to fund and the priorities it sets, it should be possible to establish a funding line on RRI within the overall budget for Horizon 2020. Therefore, the costs for implementing this measure would be low, not much more than the direct budget that would be dedicated to this funding line.

Also, no additional costs for business enterprises or research institutions would arise.

At the same time, only a limited number of actors would be affected directly by this action in the short run. It would primarily address researchers already interested in the topic who would apply for funding. Also the amount of funding affected would be rather little in the short run.

However, if the results from the projects developed under this funding line impact on future science and innovation policy making, a wide range of actors and funding schemes would be affected. Therefore, the major impacts of this option will be visible in long-term developments rather than in directly connected short term outcomes.

Harmonization capacities of this action are also rather low as it will take time until the understanding developed from the projects funded under this funding line are picked up and triggered into day-to-day policy making or research and innovation processes while in the meantime, RRI activities in the Member States continue to develop without a common framework.

4.2.3.2 Second Order Impacts

In the long run, this action can contribute to a better understanding of RRI which can eventually increase trust and change mind-sets of researchers, stakeholders and business enterprises, giving RRI a stronger presence in R&D processes and innovation.

4.3 Option 3: Improved coordination with the MS without a legally binding initiative

The actions under option 3 are designed to raise awareness for RRI in the first place as they are to be adapted voluntarily. This increased attention for RRI in R&D processes should eventually lead to a restructuring of R&D and innovation processes. Hence, this increased awareness for societal needs and ethical aspects in research and innovation will also have an impact on the efficiency of research funding in both the research and innovation systems. Indirectly these measures will also improve the training for researchers in research institutions and business enterprises, change evaluation criteria for research and set incentives for business enterprises for applying criteria of RRI in their R&D processes.

4.3.1 First Order Impacts

Compared to the actions suggested in Option 2, Option 3 covers a wider range of actors and will affect a larger amount of funding as also funding provided by the Member States and private research funding are addressed. In 2010, this amounted to approximately €184 billion. At the same time, this option addresses a comprehensive range of actors.

Overall it is very difficult to measure the exact impacts of the actions that have been suggested to improve the coordination among the Member States as these are rather soft measures that can be adopted voluntarily. Therefore, it cannot be estimated exactly, which costs for research institutions and business enterprises will arise.

Moreover, the suggested actions are about starting dialogues among the involved actors to develop a framework for RRI. As the outcome of these processes is unclear an exact, quantifiable assessment of the impacts is hardly possible.

However, it can be expected that the economic impacts will be positive in terms of a reduced risk of innovations failing after market introduction and consequently higher efficiency of public and private research funding.

As for EU competitiveness, these options would also have a positive impact as they contribute to strengthening innovation capacities in the EU.

Also, these options can have positive social impacts. The stronger emphasis on RRI in the research and innovation process can also raise awareness, e.g. for gender issues in R&D and highlight gender specific challenges.

Moreover, the raised awareness for societal needs and challenges in research and innovation can contribute to developing more socially and environmentally sustainable products. Hence, these measures can indirectly also have positive impacts regarding the environment and social cohesion.

Overall Option 3 addresses a wider range of actors and would affect a larger amount of funding than the actions proposed in Option 2. Therefore, the harmonization capacity is higher. Still, this option offers a high degree of flexibility as the adoption of the proposed standards and norms are voluntary. Also, it is up to the Member States, which measures they think are appropriate to stimulate RRI activities as the reporting scheme leaves room for choosing their own focal points which allows the Member States to adapt the concept to their own specific contexts.

4.3.2 Second Order Impacts

Because option 3 is directed to all involved actors the capacity to contribute to a process of changing mind sets of researchers, policy makers and society in general is high. The potential of increasing trust in R&D processes and their products is also high.

The specifics for the impacts expected for each of the actions will be discussed below.

4.3.3 Action 3a: Improved Coordination of RRI activities in the MS

A reporting scheme will send a strong signal to Member States that RRI is a central consideration in research and innovation policy. It will improve information sharing between Member States, from those countries currently leading these debates to those who are relatively late to the discussions. Next to raising awareness for the topic, a reporting scheme would provide a strong incentive for the Member States to facilitate the debate on RRI, learn from good practice examples and develop appropriate actions for their specific situation. Moreover, a reporting scheme will increase transparency of the measures taken to enhance RRI. Hence, it will enable civil society organizations to refer to the results of the reporting and therefore make it easier for them to actively take part in the discussion. Also, for business enterprises, good practice examples can serve as reference models for innovations in their research processes.

Therefore, the harmonization capacity of this option is very high and addresses all actors involved in R&D processes.

In this way, a reporting scheme would indirectly induce reforming research and innovation processes as RRI aspects may be considered more frequently in the design of research and innovation processes if a reporting on their implementation is asked for. This will also facilitate a more efficient spending of research funds.

However, the costs for implementing this option can be regarded as rather high compared to the other options presented here. First, the implementation of a reporting scheme will require collecting all the information on RRI activities of business enterprises, research institutions, research funders and governments. However in the case of enterprises benefiting

from public funding for their research and innovation, there would be no additional costs to the procedure aimed at allocating this funding. This may pose an additional administrative burden on the institutions and organizations that have to submit their information, but also requires the central authority in the Member States to devote some resources to bundle and prepare the information before they are passed on to the EU. Also, on the EU level, there are resources needed to supervise and monitor the submission of information.

Depending on the required frequency of information gathering and submission, these costs will vary. The more often data has to be collected, the higher the costs will turn out to be.

As this action requires the Member States to develop their own understanding of RRI and gives them the opportunity to decide on which aspects they want to report, this option offers great flexibility and can easily be adopted to the specific national contexts and activities.

4.3.3.1 Funding activities for RRI

It has been suggested that this reporting scheme can be complemented by several measures like improving funding opportunities for RRI activities also in the Member States.

Option 2 suggested several actions how to strengthen RRI in the EU's funding schemes which might also have spill over effects on the Member States. To directly address a larger amount of research funding and to enhance the adoption of RRI criteria in award procedures in the Member States, guidelines on how to include criteria for RRI will facilitate the adoption of those criteria.

The costs for implementing the guidelines will largely depend on the content of the guidelines and the situation in the Member States. If there are funding opportunities for trans- or interdisciplinary research, demand for the consideration of societal needs in the eligibility criteria or specific projects on RRI, the costs for implementation will be rather low.

Additional administrative costs are expected to be rather low for research funders as the guidelines can be included in the review process of research criteria so no additional procedure would be necessary.

Indirectly, costs for research institutions and business enterprises can occur. However, these will also depend on whether they already made provisions for including RRI criteria in their research.

However, this option does not address research spending by business enterprises although their funding represents the largest share of funding for R&D.

4.3.3.2 Setting incentives for RRI

As it has been shown in chapter 1, the largest share of funding for R&D activities is provided by the private sector. Business enterprises spend €151 billion on R&D activities in 2010. Therefore, it is essential to raise awareness for RRI and stimulate the consideration of societal needs and ethical aspects in their research projects.

Incentives from governments can contribute to achieving these targets.

Public procurement of goods and services amounts to more than 19% of the GDP of the EU 27 (European Commission 2010). Therefore, the identification of public procurement potentials in areas relevant to RRI and the development of guidelines on the use of public procurement to promote RRI can make a significant contribution to enhancing the application of criteria for RRI by creating a market for products that have been developed in a manner respecting principles of RRI. Next to raising awareness for the topic, financial support for innovations that have been developed taking into account societal needs and ethics, provides a strong incentive for business enterprises to apply criteria of RRI to be eligible for public contracts.

Therefore, this action would have positive effects on the innovation system with regard to RRI and the improvement of the efficiency of funding.

Administrative costs for the public institutions would result from following the guidelines on public procurement. However, these costs would be rather low if the public bodies comply with the EU rules on public procurement and follow the guidelines on socially responsible procurement already. The additional consideration of the research process in developing products for public use, e.g. purchased by public procurers, would, therefore, only represent another criterion in the assessment process for socially responsible public procurement.

At the same time, resources will be necessary to either revise the guidelines on pre-commercial procurement or to develop new guidelines on the use of public procurement to promote RRI. However, these costs will only have to be raised once, so no long term costs are expected.

Other impacts of such an initiative would be rather indirect as funds for research are not directly addressed nor would there result any direct costs for business enterprises.

Indirectly, an initiative like this would require adapting their research and innovation processes according to the guidelines on public procurement if the businesses want to be eligible for receiving public contracts. This increases the incentive for business enterprises to reconsider their research and innovation management. The costs for possible restructuring measures, however, depend on how these guidelines will be formulated and on how closely business enterprises already follow these guidelines.

This option mainly addresses the failures that have been identified for the innovation system as incentives are set for innovative business enterprises by putting a stronger focus on RRI in public procurement. The research system would only be addressed by this measure if research services for the development of products for public use are commissioned to research institutions.

4.3.3.3 Training activities

As a third additional measure, the promotion of training activities on RRI has been suggested.

Other than the before mentioned actions changes in training for researchers address the individual researchers. Dealing with the subject at an early stage of the researcher's education it becomes more likely that RRI becomes an integral part of their work.

Therefore, also new concepts in education and training will indirectly also improve the outcome of the R&D processes regarding their impacts on society and the environment.

The establishment of guidelines for such training activities requires a joint initiative from actors in the training and education sector which implies that resources will have to be devoted to developing a common approach. Depending on the organization of this process, the costs can vary significantly.

Also, the costs for implementation cannot be estimated as it will depend on the requirements defined in the guidelines and the degree to which they are already considered in the curricula.

4.3.4 Action 3b: Codes of Conduct for RRI activities

Development of codes of conduct either within the member states or on the European level along disciplinary lines addresses research institutions and therefore also affects all funds that are spent for research projects in these institutions.

Like the actions presented above, codes of conduct can lead to an improved efficiency of research funding leading to improved products for society and the environment. How much they can improve the situation will depend on the number of institutions that apply these codes of conduct and also on the content of these norms.

The administrative burden would also be rather low as there are no reporting requirements directly connected to applying these codes of conduct in a research institution.

Nevertheless, the development process of codes of conduct either within each Member State or for the various scientific disciplines requires the investment of public resources. Depending on the scope and duration of this process, the existence of previous norms, and how stakeholders will be involved in this process, the costs for developing codes of conduct will vary. But the resources needed for this development process would only occur once and no significant long-term costs will result.

Also, the costs for implementing the codes of conduct depend on various factors. The design and scope of the codes of conduct will determine how costly the implementation is. Also, the already existing background regulations will influence the application of the codes of conduct. If there are already similar norms that have to be followed the adoption of codes of conduct will be less costly than introducing new concepts.

Therefore, it is necessary to conduct another impact assessment to analyse the impacts on society and the environment and the costs for implementing the codes of conduct when concrete suggestions on how to design the codes of conduct have been developed.

4.3.5 Action 3c: Standards on RRI

The impacts of a management norm on RRI addressing research process management and investment management are mostly indirect. The adoption of this norm would be voluntary and in reference to ISO 26000 guidelines for societal responsibility of organizations. Hence, it is not possible to quantify which share of funding would be affected.

Nevertheless, this norm would directly address business enterprises and therefore address all actors in the innovation system. Thus, all funding invested by the private sector can potentially be addressed by this norm. Also, this norm would enable civil society organizations and governmental institutions to evaluate research and innovation processes according to the standards set in this norm.

Besides, research funders can use this standard and make compliance with it a mandatory prerequisite to be eligible for applying for funding. In this way, research funders can ensure that their funding is spent more effectively. As it was pointed out in the first chapter, it is, however, not possible to estimate the increase in efficiency in absolute terms.

As the adoption of this norm would be voluntary and there are no direct reporting requirements connected to this option but the one to shareholders, the direct costs for introducing this norm for business enterprises and research institutions would be limited.

However, it is not possible to estimate the overall costs for introducing this standard as the costs largely depend on the requirements defined by its requirements and on how closely these institutions already follow the research management process that would be suggested by ISO, CEN inspired, standard. Hence, it would be necessary to conduct an impact assessment specifically for the standard once a standard has been framed and finalized, beginning with the European level.

The administrative burden would also be rather low as there are no reporting requirements directly connected to introducing this standard.

Nevertheless, the development process of such an ISO- CEN inspired standard, requires the investment of also public resources, not only those of private stakeholders, like industry. Depending on the scope and duration of this process and which and how extensively stakeholders will be involved in this process, the costs for developing this standard can vary considerably. But the resources needed for this development process would only occur once. However, organisations have to invest into the compliance with the standard, which becomes the more costly the higher the requirements and the more rigorous the compliance should be, e.g. requiring regular certification.

It is also hardly possible to quantify the environmental and social impacts as the introduction of this standard depends on the individual business enterprises and research institutions. Also, the impact will depend on the content and specificity of the standard.

In general, it can be expected that the standard will have a positive impact on the effective spending on research funding, leading to environmentally beneficial and socially desirable outcomes of the research and innovation process. The broader this standard would be ac-

cepted and applied, the more positive the impact can be and the more the efficiency of the use of research funding can be improved, including lowering the risk of non-tariff/ technological barriers to trade and related WTO cases, especially if an international standard will be the outcome.

This action also ensures that the approaches developed in the Member States regarding RRI are coherent while still offering the opportunity to specify and highlight certain aspects of RRI and therefore providing a certain degree of flexibility.

4.4 Option 4: Improved coordination with the MS with a legally binding initiative

A legally binding initiative from the EU would have the advantage that all Member States will have to comply with the EU's requirements. Therefore, a legally binding initiative would reach the highest possible level of cohesion.

Therefore, the mandatory introduction on a regulation for RRI and a reporting scheme on RRI activities would ensure that all involved actors are addressed. Hence, also the full amount of funding for RRI will be addressed by a legally binding initiative which amounted to €245 billion in the EU 27 in 2010.

On the other hand, there are several reasons why a binding initiative can be counterproductive in the short run:

There would be administrative costs to transfer a legally binding initiative into national law. Their amount is depending on the measures that have already been taken to promote RRI in the Member States. Also, resources would have to be raised to monitor the implementation and compliance with this regulation in the Member States, research organizations and business enterprises.

Moreover, a legally binding regulation would result in costs for business enterprises and research institutions that obligatorily would have to adapt their research and innovation processes accordingly. However, it is not possible to estimate the costs for implementation as this would depend on the embodiment of the regulation.

A legally binding initiative would be less flexible and would not take into account the diversity of action of the Member States at the beginning of a process of harmonisation and convergence. Voluntary measures to promote RRI will raise awareness for the topic in general and may also stimulate the development of other approaches to promote RRI. A legally binding EU initiative in turn might thwart the development of other approaches that might also be successful instruments to support RRI.

Above all, it is questionable whether a legally binding initiative would be supported by the Member States and is in accordance with the European Union's competences in this area.

5 Comparing the options

The analysis of the options in the previous chapter shows that option 2 to 4 all offer the opportunity to improve the efficiency of research funding by enhancing the consideration of ethical aspects and societal needs in research and innovation processes.

The extent to which these options can contribute to the improvement of the situation cannot be quantitatively assessed at this point as the options suggested here are mainly about initializing processes to develop new funding programs, standards and norms for RRI and so on which will depend on policy initiatives on the national and EU level. Thus, a quantitative assessment will only be possible when these processes lead to more concrete results regarding how the options can be implemented.

However, it is possible to compare them regarding the scope of actors and amount of funding that will be affected by each option which also provides the opportunity to estimate the benefits and costs for the options in relationship to each other. The options that address a wider range of actors and a larger amount of research funding will have greater impacts on the efficiency of research funding. Therefore, a combination of option 2 and 4 would have the largest impact on impact areas such as effectiveness (affected funding and stakeholders, harmonisation capacity, added value for EU policies, etc.) and efficiency (cost for research and for doing business, administrative costs, flexibility, etc.), as well as on second order impacts such as trust building and the changing of mind-sets.

Option 4 would also have the greatest capacity to harmonize approaches towards RRI in the EU. However, option 4 is also most likely to cause the highest administrative burden and is least flexible. A legally binding initiative is also most likely not to be well received by the affected actors. To make the initiative a success it is crucial to gain support from as many actors as possible. A high degree of flexibility of the measure is needed so that it can be easily adapted to different contexts and backgrounds.

Therefore, option 3 is preferable. It offers enough flexibility and can be adapted to the respective contexts, while still providing the opportunity to harmonize approaches in the EU and to further develop them in the same direction.

Nevertheless, the actions suggested in Option 2 should also be considered, because they complement the actions in Option 3 on the EU level instead of them being mutually exclusive. Besides, it is likely that it is easier to implement these actions as it will take some time until the processes to develop concrete suggestions for implementing Option 3. In the meantime first initiatives on EU level can (1) support processes to implement option 3 and (2) serve as a starting point and role model for initiatives on the Member-State level.

5.5 Implementing the options

It has been shown that for some of the options it is difficult to measure exact, quantifiable outcomes as they are rather process-oriented and do not suggest concrete measures tar-

geted at strengthening RRI, but at establishing a framework for RRI activities that will have to be adapted to the specific national contexts.

Also, the measurement of the impacts that have been called “second order” impacts here and describe mostly changes in peoples thinking and behaviour are difficult to assess.

However, it has been shown, that the options suggested can be beneficial for the enhancement of RRI activities which in turn will make spending on research and innovation more effective and therefore contributes to Europe’s innovation capacity.

It also became clear, that the options presented are not necessarily an “either/or”, but may as well be a “both/and”. A fruitful combination could in many ways be both EU initiatives and Member States initiatives. In order to achieve a variety of benefits one solution might be to combine a “top-down” approach with a “bottom-up” approach. This way the different options could supplement each other and some of the positive impacts could be increased. Moreover, the tendency from ethics could take place also regarding RRI, starting with a few principles and leading to soft law accepted and implemented by a growing number of research funders, research institutions and business enterprises.

6 Outlining policy monitoring and evaluation

The reactions of the Member States and stakeholders like business enterprises, research institutions and civil society will be a first important test for a future Communication or Recommendation from the European Commission. If the suggestions are supported this will establish a legitimate role for the European Commission to continue the efforts to initialize a dialogue on RRI and to implement the suggestions indicated in this report.

There should be evaluation efforts to monitor the progress within the Member States regarding requirements for the consideration of ethical aspects and societal needs in research and development.

This should encompass both reform measures and outcomes of these efforts. This should be analysed in a progress report that includes:

- a review of the implementation efforts of the Commission's recommendations and voluntary codes
- the take-up of funding for RRI activities provided by the EU's and national funding schemes,
- improvements in the cooperation among the Member States.

The progress made by the actions that will be implemented should be evaluated regarding the criteria that have been identified in the problem definition. This includes an evaluation of the effects on the different actor groups and the impacts on the underlying causes that have been identified in chapter 1. Moreover, indicators should be developed to evaluate the impacts according to the impacts on the normative, substantive and instrumental dimension (see chapter 2).

This progress report can also take up the information provided by the reporting scheme that has been suggested as one action in policy option 3 and use these indicators as a starting point for working out a detailed framework for the evaluation. The indicators that have been suggested for the reporting scheme in Option 3 can also be used to measure progress in this report to review the activities on RRI. These are:

- What is the focus of RRI in the respective Member State?
- Existence of a focal point for government accountability on RRI
- Existence of a national public policy on RRI
 - objectives
 - principles (including ethics, gender, open access, education, essential values like dignity, privacy, justice, security, sustainability etc.)
 - guidelines on reporting/compliance schemes

- standards
- roadmap towards RRI with intermediate goals
- assessment indicators
- Existence of European/ international cooperations
- Existence of roadmapping and foresight processes
 - dissemination of guidelines and principles
 - do's and don'ts (rules to comply with)
 - good practices
- Provisions for transparency of RRI activities
- Existence of inspiring/reporting schemes towards entities/teams/individuals according to the levels of responsibility
- Inclusion of RRI in curricula and certification for education/ training
- Existence of research and publications on the topics
- Studies on benchmark publicly available publicly (failures, success stories)
- Availability of relevant documentation for all stakeholders (investors and shareholders, managers, consumers, citizens, suppliers, wage earners, patients, media, teachers, researchers, incubators, public authorities and procurers, etc.)
- Existence of a deliberative process for the assessment of the inspiring/ reporting scheme
- Existence of funding schemes especially on RRI
- Existence of incentives for business enterprises for RRI (e.g. pre-commercial procurement initiatives for RRI, promotion of ethical funds)

However, these indicators can also be extended or replaced by others if other priorities are set during the development process of the reporting scheme.

The European Commission should support such an evaluation scheme on RRI in the Member States by proposing a specific call on options for an integrated, joint assessment methodology based on these indicators.

This evaluation scheme can also be benchmarked with other available frameworks, methodologies and indicators. For instance, the criteria of the Chief Scientist's Unit in charge of policy monitoring and evaluation methodologies at the US Government Accountability Office (GAO) could be used. In 2012, GAO issued a methodology transfer paper that describes different types of evaluations for answering varied questions about program performance, the process of designing evaluation studies, and key issues to consider toward ensuring overall study quality. This paper contains guidance on designing an evaluation process including the identification of questions important to stakeholders and the exploration of data options. It also includes an overview on the variety of research designs and approaches that

evaluators may choose to obtain credible as well as timely answers and lays out criteria for a good design. These refer to the appropriateness of the questions, ask for a research design that adequately addresses these questions and is feasible with the available resources (GAO 2012). Furthermore the experiences of the evaluation of the Lead Market Initiative (Centre for Strategy Evaluation Services and Oxford Research 2011) including the insights of the conceptual analysis by Edler et al. (2012) should be taken into account. Especially, the complexity and the long term character of the impacts should be taken into account, as well as the interrelation between the Member States levels, the European and even the international level.

Based on the findings from this first evaluation, amendments to the measures in place should be discussed. The point of departure for this debate may be the recommendation of Option 3: the provision of a voluntary, flexible system of improved coordination with the Member States without a legally binding initiative, which nevertheless includes the establishment of Codes of Conducts and Standards for RRI. Also, the implementation of Option 2, an improvement of considering RRI in research and innovation funding programmes, including initiatives for mainstreaming RRI as well as an increased share of funding for interdisciplinary research and research on RRI, may facilitate the discussion on RRI principles in research and innovation.

In regular progress reports on the trends and developments in the application of RRI principles in research and innovation can be monitored. These reports may as well initiate a dialogue on RRI and serve as the basis for evaluations.

7 Annex I – Definition of RRI

Responsible Innovation

“Responsibility” is a philosophical notion that has become prominent in the last century in ethical theory and in moral discourse. There are various ways to explicate the term and there are many different paradigms, theories, accounts and connotations. Some argue that “responsibility” has become a central organizing concept in modern moral and social discourse. Others argue that its centrality is undeserved. In the world of work and the professions where we speak of “professional responsibility”, and in the world of international criminal and humanitarian law where we speak of “the responsibility to protect”. What responsibility in each of those cases entails is the subject of discussion and debate: How does responsibility get apportioned and distributed, what is collective responsibility, how is responsibility related to other key moral concepts, such as “duties”, “rights” and “obligations”, “needs” and “interests”? How can we be responsible in a world that is characterized by chance, complexity and emergence, how does our advanced knowledge of the brain affect our conception of personal responsibility?

Responsibility is predicated primarily of persons and only derivatively of their actions. Strictly speaking the paradigm case of responsibility is “the responsibility of a person for his or her actions –in light of his or her intentions – and their effects in the world”. We say for example that “John is responsible for the breaking of the vase”. Alternatively we can say that it was “John’s responsibility to prevent the breaking of the vase”, or that it was “his responsibility to put it in a safe place”. We can also speak of “a responsible person”. More recently however the qualification “responsible” has become attached to events and processes which are quite separate from any identifiable individual agent. We can thus also talk about “a responsible way of proceeding”, “a responsible investment”, “a responsible procedure” or an “irresponsible bonus structure”. With respect to Technology, Applied Science and Engineering we now have come to talk about “Responsible Research” and “Responsible Innovation”.

The use of “responsible” in the expression “responsible innovation” is comparable to the use of “lazy” in the expression “a lazy chair”: strictly speaking the chair is not lazy. The word “lazy” in this expression refers to chairs that invite and accommodate people who can be said to be lazy, who feel lazy, are lazy, or behave as if they were lazy. Strictly speaking it is not the innovation itself that is responsible. Responsible Innovation is a truncated and indirect way of referring to contexts in which people are the appropriate subjects of responsibility claims and who either feel responsible, or who can be held or can be made responsible. “Responsible innovation” can thus be used to refer in the realm of innovation to whatever invites, accommodates, stimulates, enhances, fosters, implies or incentivizes responsible action and the mental states that are typically associated with it.

Responsible Research and Innovation refers to ways of proceeding in Research and Innovation that allow those who initiate and are involved in the processes of research and

innovation at an early stage (A) to obtain relevant knowledge on the consequences of the outcomes of their actions and on the range of options open to them and (B) to effectively evaluate both outcomes and options in terms of moral values (including, but not limited to wellbeing, justice, equality, privacy, autonomy, safety, security, sustainability, accountability, democracy and efficiency) and (C) to use these considerations (under A and B) as functional requirements for design and development of new research, products and services.

Building on these requirements, in a European context the following points of reference should be reflected in the design of research and innovation processes and products:

1. **Ethical acceptability** which includes compliance with both the EU charter on fundamental rights as well as the safety of products regarding the acceptable risk of products.
2. **Orientation towards societal needs** which includes an orientation towards contributing to achieving objectives of sustainable development (consisting of economic, social as well as environmental aspects) and contributing to achieving normative objectives such as “equality of men and women” or an improvement of the “quality of life” which are also core European objectives expressed in the Treaty on European Union.

This implies on the one hand that RRI is directed at technological advance also fostering the competitiveness of the European economy and its innovation capacities. On the other hand RRI is directed at providing solutions to the Grand Challenges that societies face today such as environmental degradation, climate change or the ageing of society, etc. In this way, RRI serves common European values that drive EU policy.

An important distinction to be made in responsibility discourse is between (i) the articulation of the conditions of application of the concept and (ii) the determination of whether these conditions are satisfied in a particular situation. The first is a conceptual or criteria matter and the second is a moral issue. The first concerns the conditions that must be satisfied in order to be able to hold someone responsible at all, or to make someone responsible, or to put it in a different way; it concerns the felicity conditions of saying “I hold you responsible”. These types of conditions roughly correspond with types of excuses people use to deny that they can be held responsible at all, because they believe that one or more of the necessary conditions for responsibility are not satisfied.

First, there is a condition related to freedom, choice, feasible options and real alternatives and relatedly with control and the absence of force and coercion. John is not held responsible when it turns out that he was pushed, or forced at gun point, or suffers from severe obsessive compulsive disorder; when he was not in control, or linked by means of wayward or devious causal chains to what happened. Nor can John be made or held responsible if the above freedom limiting conditions are known to apply to him. From this condition it seems reasonable to assume that Responsible Innovation implies that relevant agents should have options open to them, make an effort to look for alternative courses, actively articulate alternative options, reflect about their choices and alternatives.

Secondly, there is a condition of knowledge. If John didn’t know what he was doing, did not know that his actions would cause damage, then he cannot be held responsible. If someone has lied to him or deceived him, or he was provided with incorrect information, then he can-

not be held responsible. So ignorance provides a criteria excuse. This knowledge condition is of great importance for responsible innovation. An innovation process counts as responsible only if it has been designed, organized and managed in such a way that it provides the relevant persons and stakeholders with relevant knowledge.

A third condition is sometimes referred to as “moral capacity”. People lacking in certain moral capacities, which seem required for moral awareness, perception, judgement and moral reasoning cannot be said to be responsible. As a consequence in criminal court cases persons lacking in moral capacities are then not evaluated in terms of a moral legal vocabulary but instead in the terms of a medical and psychiatric vocabulary. Applied to responsible innovation this would imply a moral capacity, sensitivity and in general a capability to evaluate actions, options, consequences and knowledge in ethical terms on the part of researchers and those involved in innovation processes.

It is important to note that those who see to it that they do not have alternative options, do not have knowledge or lack moral capacities cannot escape responsibility. Culpable or self-caused ignorance e.g. does not excuse of course. If you chose to look away from a victim in an accident, which would not make it acceptable to refrain from helping the victim, because you did not know that he was bleeding to death. In this case you could have known and you ought to have known. This is a crucial observation for our analysis, since it helps us to see that there is in this case a higher order responsibility to see to it that the knowledge condition of responsibility is satisfied. Similarly there is a higher order responsibility to see to it that the first and second criteria can be satisfied.

Important consequences follow from these conditions of responsibility for the explication of Responsible Innovation. Persons ought to see to it that these conditions are realized or optimized once they have accepted responsibility for X in a forward looking sense. If one says “I take responsibility for R&D&I project”, one accepts an obligation to actively bring about the conditions under which responsibility can be ascribed to oneself for this project: to work on alternative options, to have relevant knowledge and have the required moral capacity to evaluate options and choices in terms of their ethical acceptability and social desirability.

These considerations do not only place requirements on the research and innovation products but also requires the research and innovation process to be designed in a way that allows for the consideration of ethical aspects and societal needs. This implies an issue orientation of research and innovation and calls for stakeholder involvement in these processes. Hence, in general, Responsible Research and Innovation should aim at being (Stilgoe et al 2012):

- Anticipatory: Anticipation asks researchers and innovators to include new perspectives in the research and innovation process and to think through various possibilities to be able to design socially robust agendas for risk research and risk management.
- Inclusive: Inclusiveness asks researchers and innovators to involve diverse stakeholders (such as users, NGOs, etc.) in the process to broaden and diversify the sources of expertise and perspectives.

- Reflexive: Reflexivity asks researchers and innovators to think about their own ethical, political or social assumptions to enable them to consider their own roles and responsibilities in research and innovation as well as in public dialogue. Reflexivity should raise awareness for the importance of framing issues, problems and the suggested solutions.
- Responsive: If research and innovation claim to be responsible, if it has the capacity to change its direction or shape when it becomes apparent that the current developments do not match societal needs or are ethically contested. Hence, responsiveness refers to the flexibility and capacity to change research and innovation processes according to public values.

This shows that RRI has to be a key part of research and innovation process and should be considered already at an early stage and at different levels such as the individual scientist, research and innovation projects as well as in research programmes and the institutional level. However, individual actors will not deliver RRI on their own. Instead, RRI can be established as a collective, inclusive and system-wide approach.

8 Annex II – Examples of contested innovations

8.1 Smart energy meters and Privacy

Since a couple of years the roll-out of smart energy metering has been promoted in many European countries. The introduction of intelligent metering systems has been pushed forward by several EU directives, most importantly the Energy Service Directive (2006/32/EC) and the European Union's Third Energy Package where smart metering is explicitly mentioned in the Directive on the Internal Electricity Market (Art. 13, 2009/72/EC). Also, it is expected that the Energy Performance of Buildings Directive (2010/31/EC) will further enhance the introduction of smart metering. However, smart metering is highly contested in many societies – not only because of the expected costs for the introduction of smart metering, but also because of privacy concerns.

The most prominent example in this regard is the Netherlands: After many years of research and development a proposal of the minister of economic affairs to equip all houses with smart meters as part of a nationwide smart grid plan was also rejected by the upper house because of privacy concerns. Therefore, the mandatory introduction of smart meters was dismissed. Instead, a regulation was introduced that stipulates the voluntary introduction of smart meters (Renner et al. 2011).

Also in Austria the introduction of smart metering is debated not only because of the expected costs of this provision but also because of privacy concerns. (Renner 2011) In Slovenia, the roll-out phase for smart metering has not started yet. However, before this issue can be moved forward, there will also have to be a more detailed discussion on privacy issues, too (Renner et al 2011).

The smart meters and the plans for their introduction were smart, but a genuine innovation would have produced meters that were so smart as to be able to accommodate privacy concerns by design, and also provide the functionalities that would allow the development of smart grids. Attainments of the targets in CO₂ reduction are dependent on creating smarter electricity grids in EU zone. A responsible innovation manages by design to deal with conflicting requirements of efficiency and privacy and reconcile opposing values in truly innovative products and services. What is often considered as a deadlock situation or an unattractive trade-off between two values may often lead on to innovations exactly because we need to satisfy more than one value at the time and smart innovations are the only way to accomplish this.

The UK showed that the early consideration of privacy issues in this area and the integration in the product design, contribute to a better acceptability of this technology. The government recognized the importance of consumer engagement and released documents

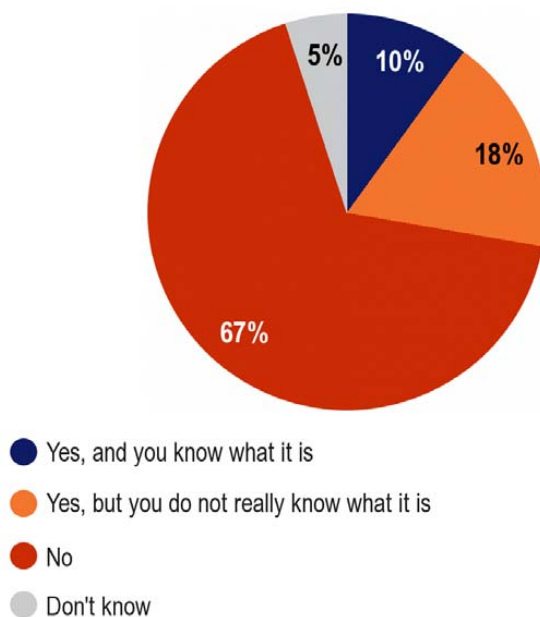
on consumer protection and privacy which were highly welcomed by consumer protection organizations (Ofgem 2010, Renner et al 2011).

8.2 CCS and Safety concerns

Another issue is the introduction of Carbondioxide Capture and Storage (CCS)-technologies which are regarded as a promising option to make coal-fired power plants more climate-friendly. Although this technology has great potential in this regard, societies in Europe increasingly raise concerns over CCS when storage in their close neighbourhood is under discussion.

A recent Eurobarometer report (Eurobarometer 2011) revealed that in general knowledge about this technology is rather limited among the population. The study examined the public attitude towards CCS in 12 European countries.

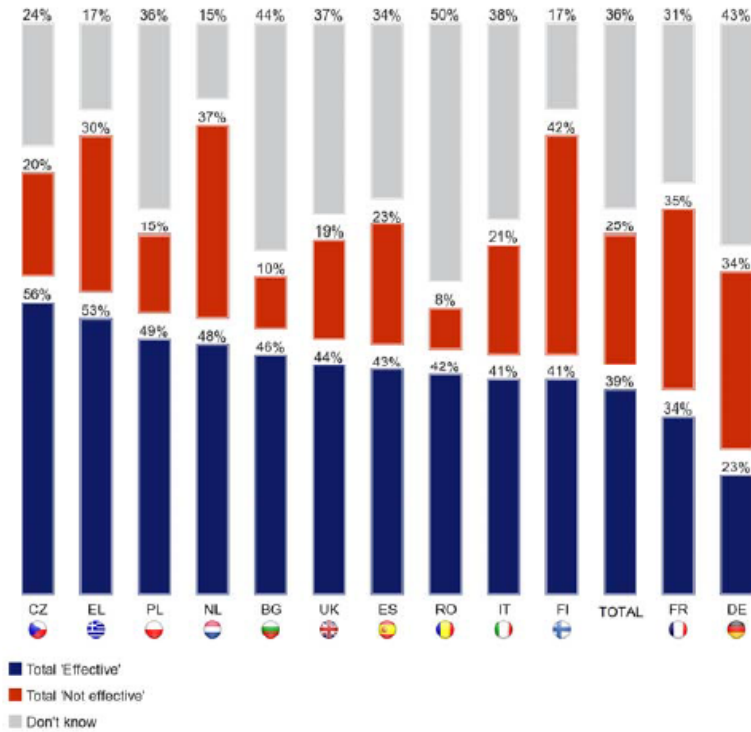
QE9. Have you ever heard of CO₂ capture and storage, also known as carbon capture and storage or carbon capture and sequestration (CCS)?



Base: TOTAL (n=13091)

Figure : Level of information on CCS (European Union, Eurobarometer (2011): Public Awareness and Acceptance of CO₂ capture and storage. Special Eurobarometer 364)

QE13. In your opinion, taking into account all you know about CCS or Carbon capture and storage, could you tell me whether you think it could be effective or not to fight climate change?

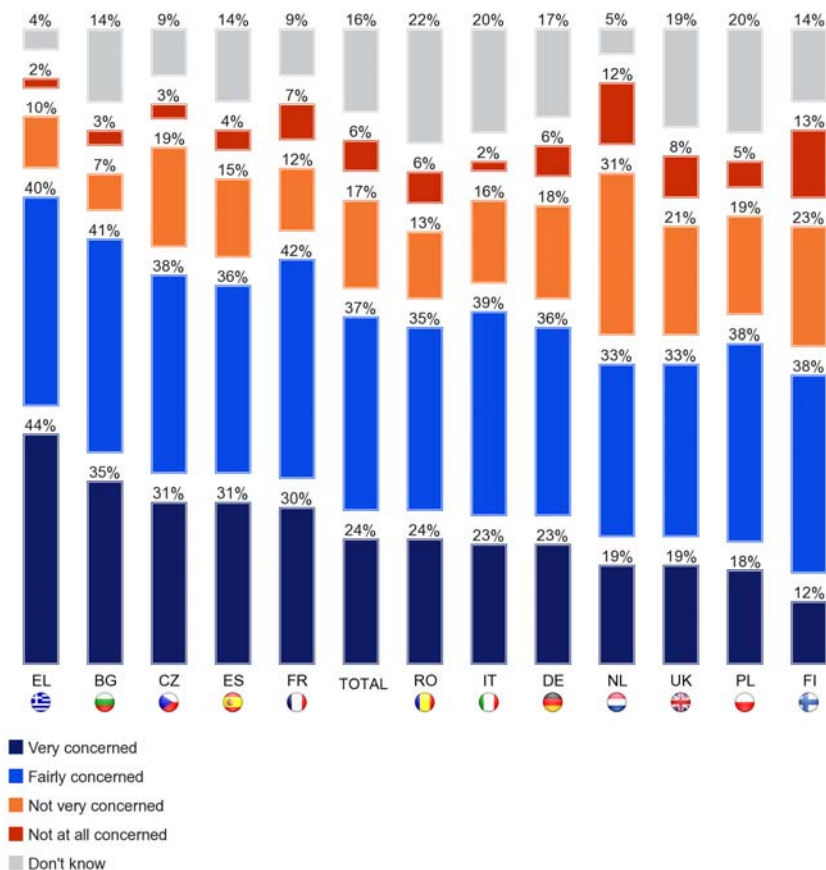


Base: TOTAL (n=13091)

Figure : Contribution of CCS to fighting climate change (European Union, Eurobarometer (2011): Public Awareness and Acceptance of CO₂ capture and storage. Special Eurobarometer 364).

On average, public opinion is positive towards this technology in general. However, 60% of the population raises concerns over their safety if CCS facilities should be installed in their neighborhood.

QE16. If a deep underground storage site for CO₂ were to be located within 5km of your home, do you think that you would be...?



Base: TOTAL (n=13091)

Figure : Concerns regarding CCS (European Union, Eurobarometer (2011): Public Awareness and Acceptance of CO₂ capture and storage. Special Eurobarometer 364).

Other studies confirm (van Alphen et al 2007) that CCS is regarded as potentially beneficial, but safety concerns are raised among citizens. These circumstances imply a risk for policy makers and companies when it comes to the implementation of CCS technology as the following example shows:

In Germany, the German Advisory Council on the Environment (SRU) raised concerns regarding the safety and security regarding CCS in an official statement. (SRU 2009) Also, other environmental Organizations like Greenpeace or Friends of the Earth (BUND) contested CCS-technologies in the public debate. (BUND 2011) Moreover, citizens have protested against the construction of storage facilities in their locations. These developments extended the debates on the legislation on this technology in parliament. Although the parliament finally

adopted the draft legislation, the act did not come into effect, because the Länder refused to give their approval in the Bundesrat (Energie-Chronik 2011).

Because of these developments Vattenfall had to take the decision to put on hold investments that amount to billions. For example, the EU had already approved funding of €180 million for this project which could not be realized because of the concerns of some of the German Länder and their citizens (Wetzel 2011).

However, CCS-technologies are still regarded as a promising technology to contribute to climate protection and business enterprises continue to invest in research and development in this area. But also in other European countries, like for example the Netherlands (Feenstra et al 2010), citizens raise concerns over these technologies. The early consideration of their demands can therefore help to make this contested innovation a success.

8.3 Patient cards in the Netherlands and Concerns of Privacy

Many countries across Europe are considering the introduction of Electronic Patient Record Systems, but privacy concerns are widely seen as an obstacle to their development and use. The Dutch government invested about €300 million in the development of an EPR system that provides summaries from healthcare records for the purpose of exchanging medical information nationwide. However, the upper house of the Dutch parliament rejected the proposal to introduce the EHR because there have been strong concerns whether this system sufficiently takes into account aspects of privacy control (VWS 2011). Responsible Innovation and Research would have made it possible to accommodate privacy concerns in the design of the system.

9 Annex III - Successful innovations

In Germany, the societal debate and an ambitious environmental policy – partially as a result of controversies introduced by the politically prominent Green political movement – created clear focus on the development of environmentally friendly technologies. Innovation was the way to overcome the clash of two deep societal concerns (Van den Hoven, e.a. 2011): 1). economic prosperity and growth and 2. environmental protection. Such ‘innovative’ technologies, e.g. the catalytic converters for exhaust gases, fuel efficient cars, recycling technologies, wind turbines or solar panels have been successfully introduced not only in the domestic markets but have also been exported. Germany has now evolved a lead market for environmental technologies which nowadays accounts for almost 10% of the GDP, and continues increasing (Jänicke/ Jacob 2009, Bleischwitz et al 2009).

The development is not limited to Germany; green technologies are becoming economically important across Europe. For example, research and innovation in the field of renewable energy contribute to the current transformation of the European energy system from fossil fuels to renewable energy sources. The gross final consumption of energy from renewable sources increased from 8,5% in 2005 to 11,6% in 2009. Wind energy already accounted for 10% of the total European electricity generation capacity in 2011 (EC 2011b; EC 2012a). If the criticisms would have been stifled, environmentalists ostracized, and social tensions concerning the environment in the 70s and 80s in Germany managed politically, they would not have been able to fuel the technological innovations that bring economic benefits 30 years later.

A similar phenomenon can be observed in the field of privacy and data protection. Very strict EU data protection laws have triggered an industry of privacy enhancing and security technology. IBM’s privacy lab is located in Zürich and some of the strongest groups in the world in privacy by design tools are located in Europe.

10 Annex IV – Unattended fields

10.1 Scientific opportunities

Tropical diseases (including malaria) and tuberculosis account for 12% of the global disease burden. In the period 1975-2004 a total of 1,556 new medicines were developed. Only 1.3% (21) of these medicines were against tropical diseases. The remainder of 98,7% was developed for other diseases (Chirac P, Torreele E., 2006).

This imbalance is caused by a number of factors, among which the IPR issues and low economic capacity of local authorities and companies to access the licenses and to deploy these drugs in their territories, a situation that de-incentivises companies to invest in areas of uncertain returns. Another cause for this imbalance is the lack of awareness and motivation of researchers to approach these diseases, in many cases simply because they are not confronted with their effects in their private lives. In the absence of political and economic incentives and of research attention, few opportunities are left for developing solutions to these diseases. For instance, Synthetic biology could be limited by this absence. Such data should help to target areas of work for researchers whose activities could have a huge impact in terms of life savings and overall welfare. The scientific problems they pose are as challenging and exciting (if not more) as the ones linked to the research of any other medicine.

10.2 Business opportunities

One success story from “The United Nation Development Programme – Growing Sustainable Business (GSB) for Poverty Reduction: Investments for pro-poor Goods and Services” was the case of rural telecommunication in Tanzania. One of the strategies of the GBS-Programme is to increase access, trust and accountability by engaging low-income people as intermediaries and building on their social networks to find out about their needs and demands and to get a better understanding of the constraints that had limited the development of an ICT infrastructure before. In the case of the Tanzania project, it resulted in an innovative business model for rural telecommunication with one network shared by 4 operators that dramatically lowered the cost for single user. The results of the Tanzania project show that the expected phone usage growth could be raised to 75%, which implies significant business opportunities for companies providing ICT infrastructure and services. The engagement of the company Ericsson in Tanzania was key to its success. More details on this example and other success stories can be found at: http://www.scienceagainstopoverty.es/Recursos/documentos/Programa/ppt/d2/Thomas_Sales_ppt.pdf (for this example see slide 32 of the PPT presentation)

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This expert group report on the State of Art in Europe on Responsible Research and Innovation has been authored by an interdisciplinary group with experts from science, innovation, economics, law, governance and ethics'. It was prepared as an intermediate step in the reflection on future policy initiatives regarding Responsible Research and Innovation (RRI). Currently, various policy discussions are taking place regarding RRI, both inside and outside of the European Commission. In order to provide input to these policy deliberations, this group was asked to reflect specifically on policy options with regard to a possible Communication or Recommendation from the European Commission on RRI.

Research and Innovation policy

