

Recommendations on priority measures for EU policy mainstreaming on adaptation

“Climate Proofing” of key EU policies:
report for task 3

In cooperation with



ENVIRONMENT AGENCY AUSTRIA **umwelt**bundesamt^U

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Report details

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Executive Summary

The EU adaptation framework

One of the four pillars of the EU adaptation framework is "integrating adaptation into EU key policy areas," which identifies the need for mainstreaming adaptation responses into all areas of EU policy that are impacted by climate change (EC 2009, White Paper). The objective of mainstreaming climate change adaptation is to ensure that sectors are able to carry on with their core tasks even within the circumstances of a changing climate. Therefore, the EU White paper on adaptation strongly recommends the climate proofing of policy areas. It serves as basis for the elaboration of the EU adaptation strategy.

Mainstreaming adaptation into existing EU policies aims to ensure that the chosen policy areas are able to better cope with current and future major threats identified and further refined.

The approach of the project 'Climate Proofing'

Based on an assessment of climate scenarios, potential impacts, damage costs, adaptation costs, effort to address climate change in policy making and the current research efforts on EU level the following sectors have been selected in a coordination meeting with the European Commission to be further investigated in this study. The arguments for inclusion are stated as follows:

- Energy: low research and adaptation activities but medium to high estimated adaptation costs
- Agriculture: enough reliable data and information but support the current on-going process of policy formulation is needed as agriculture is one of the main drivers for land use, soil quality and water use.

- Infrastructure and transport: low research and adaptation activities but high estimated adaptation costs
- Urban areas, buildings and telecom: no/limited adaptation effort although high damage and adaptation costs to be expected.

For all of these sectors considerable gaps in policy making in relation to including adaptation exists. There is a clear need to use every possibility to include adaptation to climate change in the revision of the related policies. The study provides clear recommendations on how to do this for the most relevant directives, decisions or other policy relevant documents.

Amendments of existing policies or new legislation will mainly be triggered by other purposes than mainstreaming climate change. Nevertheless, all major EU policy initiatives and legislative proposals have to undergo an impact assessment. The Commission guidelines for carrying out impact assessments (EC, 2009) are, for the analysis of environmental impacts, requiring considerations on the climate and in particular whether the option assessed affects the ability to adapt to climate change. Thus, the impact assessment procedure is seen as an important instrument to assure mainstreaming adaptation. Not all policy initiatives and legislative proposals are subject to an impact assessment though; the precise scope of application is decided on an annual basis and is published as roadmap¹ together with the Commission's Annual Legislative and Work Programme (CLWP).

Further several technical adaptation measures in these sectors have been examined with regard to their costs. The measures to be analysed have been selected from a broader range of possible

¹

http://ec.europa.eu/governance/impact/planned_ia/planned_ia_en.htm.

measures and are predominantly regret measures. Hence, their costs are all the more important in order to evaluate their economic consequences.

Some key findings of the cost assessment

The cost assessment delivered the following key findings: In the **agriculture sector** costs of around 330 million € p.a. can be expected for additional irrigation demand, ignoring the internal and external costs of water consumption. Additional advice units with regard to the farm advisory scheme could cost up to 197,5 million € p.a. (if the scheme would be made compulsory for all farms receiving direct payments). In the **energy sector**, there may be adaptation costs in the electricity grid of around 650 million € p.a., and a comparable amount of ca. 630 million € p.a. for additional or enhanced cooling of thermal power generation. The costs of setting energy standards for cooling devices could not be estimated reliably but could cause gross costs to the consumers of up to several tens of billion € p.a.. In the **transport sector** various measures have been cost-assessed: Slowing down trains in order to avoid track-buckling could cost between 58 and 260 million € p.a. in terms of delay costs. The hard infrastructure adaptation of roads and runways in order to meet higher temperature and precipitation loads may result in costs in the order of magnitude of some billion € p.a., with higher costs for heat-resistant surfaces than for enhanced drainage systems. For inland navigation, the one-time installation costs for additional hydrological monitoring stations have been estimated in the order of magnitude of 20 million €. Annual maintenance costs may increase then by 4 million €. In the domain of **urban areas**, city-specific costs of green spaces and green roofs have been investigated. Assessed costs of green spaces are the opportunity costs of foregone profits on the economically used area which is lost by the creation of a new green space.

These costs may be substantial, amounting to around 10 billion € p.a.. Costs of green roofs may reach a magnitude of 7 billion € (one-time installation) and 100 million € (annual maintenance).

Some of these cost estimates for the EU27 are summarized hereby:

<i>Sector</i>	<i>Adaptation measure</i>	<i>Costs (million € p.a.)</i>
Energy	Strengthening electricity networks (transmission and distribution)	650
	Cooling of thermal power generation	630
Transport	Adapting road infrastructure to heat	3,000 to 8,900
	Adapting road infrastructure to higher precipitation	28 to 140
Urban areas	Additional green spaces	10,000
Agriculture	Additional irrigation	330

All these figures have to be interpreted with care, since they are subject to high ranges of uncertainty and various assumptions. They are incremental costs of adaptation and are calculated as gross costs, which means any kind of benefits are not accounted for. They are, however, plausible rough estimates of adaptation costs for a range of measures feasible in the EU27. It is a striking fact that those estimates which are – with certain caveats – comparable to existing top-down estimates seem to be lower than suggested in these top-down studies. Some measures have never been cost before on a European level and a meaningful comparison is not possible.

Knowledge and research gaps

During the estimation, several knowledge and research gaps became apparent: First, the literature base of bottom-up case studies which contain some information about adaptation costs is extremely weak. More cost studies – even on local or regional levels – would certainly increase the reliability and validity of the chosen approach. Second, these studies often do not indicate their exact underlying assumptions and scenarios.² In other words, adaptation costs may be assessed, however without knowing to what one adapts. This is a severe caveat of the underlying literature as the comparability and transferability of results is very problematic in the absence of this information. Furthermore, for some climate impacts the current state of vulnerability assessment is not very advanced. We faced this problem when focussing on flood protection of power plants. As different kinds of data are needed (location of power plants, hydrological runoff modelling, topographical data and existing protection measures) a sufficiently detailed vulnerability assessment was not possible. The same holds for urban adaptation, as the vulnerability of cities depends on many factors on the local level, such as air lanes, building and vegetation density. Fourthly, the modelling of many autonomous adaptation measures is still in its infancy. In the literature nothing is said about how many power plants may be equipped by additional cooling systems, or how many green roofs may be installed due to climate change. Other interesting cases of elasticity still missing in the literature include the expected response of road planners to more climate

extremes and the additional installation of early warning systems if the flood risk increases. Econometric analyses with some rough indications of such cases of elasticity would be a significant step forward for the adaptation research. Fifth and finally, some adaptation measures are so site-specific that general unit cost estimates do not exist and their averages are very difficult to derive. This is the case for cooling systems (for power plants as well as for houses and stables), to a lesser degree for transport infrastructure measures and also for urban measures.

Though these caveats, the results are considered as a reasonable first rough estimate of key adaptation measures in the four analysed sectors. As the literature on adaptation costs grows, the chosen methodology may yield more reliable results – however they will always have to be interpreted with care since the transfer of bottom-up results to other contexts bears a considerable error risk. It can only be the second best solution if time and budget constraints do not allow a case-by-case approach.

The next multi annual financial framework of the EU allows to include some of the measures mentioned above and to help regions to adapt. However, besides providing direct support to adaptation it is essential that other projects which are developed for other purposes are climate proofed. This can be ensured by specific funding criteria and an improved Environmental Impact Assessment Directive.

Beside several sector specific research need for all sectors more research is needed on the costing of measures. The available literature sources often allow only an uncertainty range which encompasses several orders of magnitude. There are also uncertainties regarding the modeling of adaptation as well as the definition and transfer of unit costs. Therefore in many

² E.g. in the case of adapting the energy infrastructure: Martikainen et al. 2007, RTE 2010, Swedish Government 2007; in the case of adapting road infrastructure: Tröltzsch et al. 2011

cases the (gross) costs of adaptation measures are not well understood.

Also there is a need for a better understanding of the impacts of the suggested measures, especially of autonomous adaptation. It is still difficult to separate pure climate change adaptation measures from adjustments to e.g. an increased volume of traffic. Further research is needed to find out more about these special adaptation measures.

Finally, there exists huge uncertainty about the climate impacts on some sectors like soils or fisheries due to multiple impacts likely to increase in intensity with time. Substantial impacts of climate change are already apparent. Nevertheless, in many cases the scientific proofing and differentiation between human use impacts and climate change impacts are still needed.

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Introduction

One of the four pillars of the EU adaptation framework is "integrating adaptation into EU key policy areas," which identifies the need for mainstreaming adaptation responses into all areas of EU policy that are impacted by climate change (EC 2009, White Paper). The objective of mainstreaming climate change adaptation is to ensure that sectors are able to carry on with their core tasks even within the circumstances of a changing climate. Therefore, the EU White paper on adaptation strongly recommends the climate proofing of policy areas. It serves as basis for the elaboration of the EU adaptation strategy.

In the context of the run-up to the elaboration of the 2014 – 2020 multiannual financial framework of the EU, DG Climate started to seek for options how future EU budgets could be used to meet challenges imposed by climate change. The concept of "climate proofing" entered the debates as a means to integrate climate policy into the broader arena of the EU budget. In this context it is also essential to ensure that projects which receive funding under the upcoming multi annual financial framework (MFF) 2014-2020 can contribute to adaptation in addition to their initial purpose and are not risk to fail to perform because of climate change.

Having this in mind the objective of the study has been to:

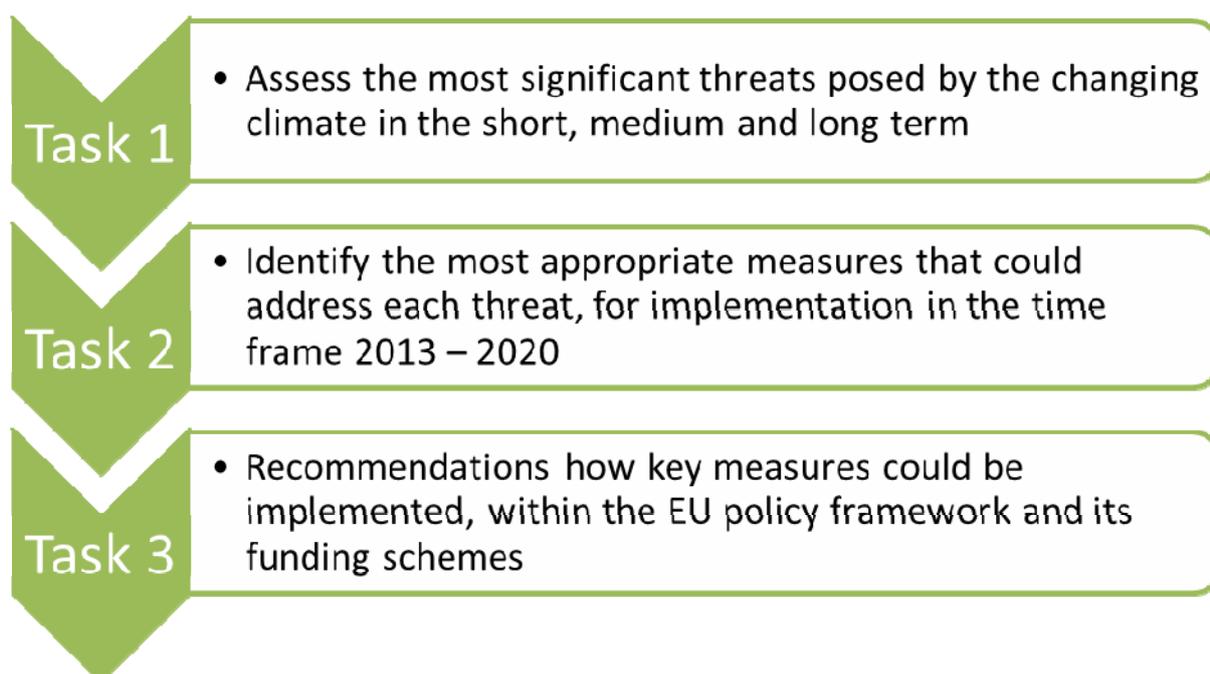
- To assess the most significant threats and challenges posed by climate change to the EU, based on what was already set out in the EU White paper on adaptation.
- Identify the main challenges for EU policies to address these threats. Focus is on those policies where currently no or little action has been taken. The key EU policy areas which have been identified on the basis of the analysis described above, in close coordination with the Commission.
- Identify the most appropriate measures that could be taken or adjusted to address these threats up until 2020 and to assess their costs and analyses their socio-economic impacts³). The focus will be on measures in policy areas where currently no or little action has been taken on the EU level so far and which are currently not subject to ongoing assessments. The recommended measures should cover 2 aspects:
 - targeted adaptation measures to be included in the next financial perspective of the EU
 - Propose ways of how to make sure that measures funded under the next financial perspective of the EU are climate resilient (climate proofing)
- Assess how to climate-proof the existing policies to support the implementation of the identified measures.

³ Social and environmental impacts might not be fully covered due to the limitations in resources and time.

Methodology applied

The study has been divided into three tasks of which each was dedicated to a specific stage of analysis. The present report forms the conclusion of the study. By drawing from results of the task 1 (Altvater et al. 2011a) and task 2 (Altvater et al. 2011b) reports, it states recommendations on how key measures could be facilitated within the EU policy framework and its funding schemes. Overall the main steps can be summarized as in the following figure.

Figure 2-1: Graphical description of the methodology



In the following section more detailed approaches for each task will be described.

1.1 Task 1: Assess the most significant threats posed by the changing climate in the short, medium and long term.

Decision-makers need information regarding future changes in climate average and variability to better design and implement adaptation strategies. For this they need to know the threats posed by the changing climate, their severity impacts and costs. However future climate patterns and human developments are difficult to predict. In order to cope with this uncertainty a set of scenarios was considered, which provided a realistic range of future changes in the variables of interest. At the beginning of the project, the Commission agreed with the contractor on: i) the climate change scenario(s) that should be used as a basis for assessing climate threats, and ii) the level of likelihood at which a threat should be taken into account.

In a next step the most important threats for these policy areas posed by the changing climate at different time scales have been analysed. The threats have been subsequently

ordered in terms of the amount of potential damage caused by inaction regarding the economic, social and environmental costs, to the extent the available literature allowed and - because of the subjective nature of the choices to be made – in consultation with the Commission.

The work under task 1 has been divided into three subtasks as follows:

2.1.1 Task 1.1: Assessment of the existing climate scenarios to be used as a basis for assessing climate threats

The aim of this subtask was to analyse the most common climate and socio-economic scenarios for Europe such as ENSEMBLES, PRUDENCE, PESETA and SCENES scenarios. The focus of the assessment was on scenarios that address the EU territory (as findings of global or national and regional assessments would need to be adapted accordingly to represent the different climate threats in adequate proportions). Under this task also insight into the uncertainties related to the different scenarios was provided.

The work performed was mainly desktop based by reviewing literature and analyzing existing scenarios. Scenarios are useful tools for exploring key uncertainties that may shape the future. These scenarios provide a reference point for mid- and long-term strategic planning of adaptation measures in Europe, alert policymakers and stakeholders about emerging problems related to climate change impacts (e.g. droughts, water scarcity, food hazards), and allow to test the adaptive capacity of key EU policies.

The deployment of a range of scenarios was realized. Using one scenario would not only be misleading since it would ignore key uncertainties in climate projections (e.g., in some cases even the sign of projections differs between different scenarios and different models), but it would also limit the ability to use the information that is available which is based on scientific research using a variety of scenarios. Moreover, the selection of one scenario would be inconsistent with the purpose to “agree on the likelihood at which an adaptation threat should be taken into account”, since generally climate scenarios are developed without quantifying any degree of confidence or likelihood, therefore there would be no scientific basis for such a selection.

Therefore only the most common and relevant scenarios for Europe have been assessed. The climate change scenarios considered the SRES scenarios used in the preparation of the IPCC AR4 assessment of European impacts (Alcamo et al., 2008) and in number of large EU projects such as ENSEMBLES and PRUDENCE (e.g. Déqué et al., 2007). Further the EU SCENES project, scenarios for rural Europe developed within the EURURALIS project (Westhoek et al., 2006), or regional scenarios developed for the PESETA Project (Ciscar et al., 2009) have been assessed.

2.1.2 Task 1.2: Identification of main climate threats

Climate change threats are important to design key EU policies and take adaptation measures, but the opportunities due to climate change should also be taken into account and strengthened when designing EU policies. Therefore this task assessed both opportunities and threats. A threat was defined as a climate-related process or event that will have

potential negative effects, and an opportunity as a change having potential positive effects. The threat assessment considered the full spectrum of climate-related impacts on EU policies (i.e., changes in temperature, precipitation, river discharge, etc.) for each of the selected policy areas.

The threats and opportunities of climate change for different sectors across Europe have been identified at different time scales on basis of comprehensive literature review. The available literature included the EU PESETA project (Ciskar et al., 2009, Iglesias et al., 2009), the EEA indicator-based assessment (EEA, 2008), the IPCC AR4 assessment of European impacts (Alcamo et al., 2008), the EU project Climate Adaptation – modeling water scenarios and sectoral impacts (whose results are not published yet but are available to the authors of this proposal), the AEA assessment on adaptation in agriculture (Iglesias et al., 2007), some national assessments such as the Finish assessment for the electricity network (Martikainen et al., 2007), US impact assessments for the transportation system (TBR, 2008) and ports (Gallivan et al, 2009) and other publications and results available from national and international research.

2.1.3 Task 1.3: Ranking of main threats and identification of the main policy areas linked to these threats

After identifying the main climate change threats and opportunities in the previous task a threat assessment was carried out following four steps:

1. Design a framework for ranking the threats;
2. Link them to the EU policy areas;
3. Meeting with the Commission to rank the threats;
4. Ranking of the threats on the basis of the framework and the meeting.

First a framework was designed for ranking the identified threats on their impacts. A wide variety of criteria to served as the basis of this ranking, including likelihood, magnitude and distribution of potential impacts, the effectiveness, costs and co-benefits of possible response actions, and others. Defining and weighing such criteria is by definition subjective and policy-triggered, and therefore was only determined in consultation with the Commission at the first interim meeting.

This consultation was proposed to take place on the basis of a simple framework, which took into account aspects of the threats such as at which scale they take place, what is their magnitude and distribution, when and with which likelihood they might occur. The seriousness of the threats was visualized in excel sheets (annex of task 1- report) based on such criteria that primarily relate to the physical exposure and societal vulnerability.

The ranking in terms of priority for policy interventions took also into account aspects that are related to the characteristics of the sectors under consideration that determine the possibilities for responses. For example, the lifetime of investments can be taken into account: for a sector with adaptation options with long lifetimes (e.g.; building dikes, public services infrastructures) a worst case approach may be taken (low likelihood-high impacts), while for other sectors responses may have a much shorter lifetime (e.g.; agricultural cropping patterns), also less pessimistic scenarios may be considered, allowing for course

corrections when the climate may result to change faster and more extreme than assumed, or less fast and extreme. Other stakeholders in the selected sectors have been consulted via telephone to give their views on priorities of the threats.

Adaptation should not be performed decoupled from existing policies (e.g. legislation, funding systems). So it was important to link the identified threats to EU policies. This was done by an assessment of about 25 policy areas analyzing to which extend these areas already include the issue of adaptation. Furthermore, the commission (DG Climate Action) named key contact persons at pertinent DGs (e.g. ENV, AGRI, TREN, REGIO) that might be contacted by project partners to obtain in-depth information on most recent developments in key policy areas to be considered.

In the forth step the outcomes of the consultations with the Commission was used as a basis to rank the threats and the policy areas for which further investigations should be carried out. These policy areas are: i) transport, ii) energy, iii) urban areas, iv) agriculture.

1.2 Task 2: Identify the most appropriate measures that could address each threat, for implementation in the time frame 2013 – 2020

The aim of this task was identify the most appropriate measures on the EU level to address the threats identified under task 1. A final selection of measures to be assessed with a view to their costs and economic, social and environmental impacts was agreed at the first interim meeting with the Commission. Measures already part of EU wide assessment projects were no part of the assessment.

1.2.1 Task 2.1: Screen key policy areas and identify adaptation measures

Adaptation should not be performed decoupled from existing policies (e.g. legislation, funding systems). Thus, relevant instruments in place for the key policy areas mentioned above have been reviewed in the first step to understand to what extent adaptation considerations are already addressed in the existing policy framework. Based on the review further measures necessary to respond to the impacts of climate change as well as adjustments of existing policies have been identified. These actions consider technical measures as well as possible supportive actions (i.e. through elaborating guidelines, establishing funding provisions). The compilation of adaptation measures was built on a comprehensive literature review: (i) analysing existing work done on adaptation measures (e.g. Hallegatte 2008, De Bruin et al. 2009, EEA – SOER); (ii) screening relevant EU projects focusing on adaptation measures (e.g. ADAM); (iii) analysing national adaptation strategies (from countries in Europe, North America and Australia) and (iv) learning from available good-practice examples.

The outcome was a list of measures and policy actions indicating the EU policy under which they could be implemented. While not going into detail on the way of implementation, the outcome of task 2.1 included a first assessment of whether accompanying measures can be established to support “climate proofing” of existing EU legislation (e.g. guidelines, funding instruments) or whether legislative adjustments and new instruments would need to be implemented. A final selection of technical measures agreed with the Commission was further processed in terms of costing (task 2.2) and the assessment of impacts (task 2.3).

1.2.2 Task 2.2: Costing of future key measures

The aim of this subtask was to develop and apply an appropriate methodology to cost some of the technical measures identified under subtask 2.1. The focus lied on direct costs (new investments, retrofit and maintenance).

In the literature, there are two main approaches to estimate adaptation costs. The top-down-approach evaluates total climate change impacts and the optimal adaptation level. However, it neglects the specific characteristics of concrete adaptation measures, which are important for evaluating the impacts of real adaptation policy. Furthermore, the top-down-approach can rarely distinguish between private and public adaptation – a question of high relevance for designing adaptation policy at EU level. The other stream of economic evaluation is the bottom-up-literature, often focusing on specific adaptation options in a specific period and location, and a certain political, societal and natural context. The costing exercise in this project extensively relied on this kind of literature, since only bottom-up studies allow a sufficiently detailed insight into the cost drivers of adaptation measures.

As financial and time resources were limited not various case studies for all of the measures identified under subtask 2.1 have been performed. Instead, the benefit transfer methodology was applied. In this context, the term “benefit” should be understood as adaptation cost estimates from site-specific case studies.

Where data were available, a well-reasoned transfer of cost estimates to new settings is feasible and will be performed. Possibly necessary presumptions were clearly stated, and uncertainties within the transfer have been indicated. The aim was to conclude from several case studies with local character to an empirically-grounded cost estimate for adaptation costs in the total EU, for those measures identified in subtask 2.1. As quantitative data on adaptation cost is still very rare, the analysis was limited to direct costs (i.e. costs for new investments, retrofit and maintenance) and mostly had to neglect indirect and transaction adaptation costs (e.g. opportunity costs by foregone alternative investment, costs of adjustment of existing regulation). However, qualitative indications of these kinds of costs have been presented where available in the context of the economic assessment of adaptation measures in task 2.3. Moreover, the quantification of net costs (including the damages avoided by adaptation) is still too speculative to be used in concrete policy advice; therefore benefits of adaptation were also treated in a qualitative manner within task 2.3.

Beside the estimation of total costs incurred by a specific adaptation technique in a certain context, it was crucial to identify the role of the public sector in adaptation processes. Total costs may be high in some cases; however they may be borne by private agents. The scarcity of resources amplifies the necessity of these considerations, facilitating the efficient spending of financial resources. In order to quantify public responsibilities in the examined adaptation measures, an approach applied in a recent EU research project (“The Fiscal Implication of Climate Change Adaptation”) was further refined and utilized. Based on databases, literature and theory, public shares of economic activities were identified and combined with total adaptation costs in each sector. Thereby the evaluation took account of private adaptation measures which were not directly subject to EU policies and focus on the adaptation measures relevant for public policy.

The benefit transfer was build upon various case studies of adaptation strategies in Europe. Detailed and in-depth research was already performed for the cases of Germany, Finland

and Italy. In this project, a systematic evaluation of adaptation cost literature was provided in matrix format. This work served as a starting point for assessing the literature concerning adaptation in other EU member states.

For the analysis of the public role in adaptation the databases of Eurostat and national statistic offices have been utilized.

1.2.3 Task 2.3: Assess economic, social and environmental impacts of key measures

In this subtask the potential effectiveness and impact of the identified technical adaptation measures have been assessed. The task was performed in close connection with the preceding task “Costing of measures”: The costing of key measures was fed into the assessment of economic impacts and costs/benefits, while the assessment of social and environmental impacts was introduced into the costing task to the extent that these can be expressed in monetary values.

The assessment did not only consider the adaptation effects of measures, expressed in terms of reduced vulnerability and net impacts, but also other criteria, e.g. those distinguished by the UNECE (2009) have been taken into account in a qualitative fashion, such as side effects (win-win, no regrets, spill-over), efficiency (economic cost and benefits), possible opportunities and supportive measures at relevant levels (legitimacy and equity, feasibility of implementation, alternatives, and urgency and priority). The European Commission’s Impact Assessment Guidelines (January 2009) have been taken into account to the extent applicable, especially when checking for economic, environmental and social side-effects of measures. However, the assessment focused on quantitative analysis to the extent allowed by available data and knowledge supported by qualitative analysis.

The assessment criteria are drawn on four broad categories of criteria, based on EEA (2009):

Figure 2-3: Assessment criteria: Four broad categories of criteria used in task 2.3

Basic information	Basic description of the measure
Effectiveness of the adaptation measure	How and when does the measure achieve the intended adaptation effect – 4 dimensions (relevance, urgency, interactions, flexibility)
Efficiency of the adaptation measure	Relation of costs and benefits
Side-effects	Economic, environmental and social side-effects

In performing this subtask a number of completed and ongoing studies have been analysed. These included cost-benefit analyses of adaptation options under the German Adaptation

Strategy, as well as projects on adaptation in the water sector which also cover co-benefits of adaptation measures. The analysis incorporated the available literature on the economic, environmental and social effects of climate change and adaptation. Regarding impacts of climate change to be avoided by adaptation measures, the task was closely related to subtask 1.2. Key reference studies at the European level include the PESETA project (Ciscar, 2009) and the EEA study on “Vulnerability and adaptation to climate change in Europe” (EEA, 2005). This was complemented by national case studies and methodological work on the national level, including the Dutch Routeplanner project (van Ierland, 2007), which aims to provide a systematic assessment of potential adaptation options to respond to climate change in the Netherlands, and the methodological study “Costing the impacts of climate change in the UK” (Metroeconomica, 2004), which has been used in different UKCIP studies. Studies from outside Europe have been taken into account where relevant.

1.3 Task 3: Recommendations on how key measures could be implemented within the EU policy framework and its funding schemes

The aim of the third task was to develop clear recommendations how key measures could be implemented and funded, within the EU policy framework. Recommendations have been given for a selection of measures analysed in Task 2. The output of this task contained two main elements:

- 1) Recommendations on priority ‘mainstreaming’ measures, including how they could be implemented. Therefore the policy gaps have been further analyzed and concrete amendments of existing legislation have been proposed.
- 2) Recommendations on how EU funding mechanisms need to be adjusted in the 2014-2020 period in order to ensure adequate funding for the priority mainstreaming measures. The recommendations focus on the four broad EU funding areas of Agriculture and Fisheries, Cohesion and Structural Funds, TEN-E and TEN-T funds, and RTD funds. In order to do so the existing regulative framework for funding was thoroughly reviewed with a special focus on the possible implementation of climate resilience criteria and adaptation measures.

Setting the baseline - Summary of EU threats to climate change and gaps in policy making

Sound information regarding future changes in climate average and variability is a prerequisite for designing and implementing appropriate adaptation strategies. Based on the identification of adaptation needs on the EU policy level, potential impacts of climate change and related current and future threats to the European Union have been outlined in task 1 (see Altvater et al. (2011)).

1.4 Potential impacts

Climate change can cause threats and opportunities for Europe. The main climatic drivers are temperature rise, changes in precipitation patterns, changes in intensity and frequency of extreme weather events (extreme precipitation, heat waves, cold spells, storms), sea level rise and changing wind patterns. These climatic drivers have an impact on the environment (water, soil, nature) and on society. These climatic drivers lead to impacts on the European environment and human society because they alter water systems, soils and biodiversity.

Impacts on water systems

With more drastic changes in climate towards the end of the 21st century, serious climate change impacts on water quantity and quality are expected in most European regions. Extreme precipitation events are likely to happen more often and to become more intense. These may lead to high river flows, leading to flooding, loss of lives and economic damage (capital stock and infrastructure). The risks of flooding also increase due to population growth and cumulative economic investments, which leads to higher potential damages. Rising sea levels increase the risk of coastal floods, with a related risk of water pollution. Water availability tends to decrease in most European regions. The Mediterranean and eastern European regions will be the most vulnerable to water scarcity and drought due to climate change, while large parts of Europe might suffer from water stress due to an increase in water use. Throughout Europe the competition for water will increase.

Impacts on biodiversity

Biodiversity is already declining because of human expansion. Rising temperatures and changing precipitation patterns lead to northward moving of suitable climate zones for species, which puts biodiversity even more at risk. Environmental quality will change negatively as a result of climate change. A higher frequency of extreme events such as droughts and floods may lead to increased danger of extinction of local populations. Loss of ecosystems may lead to a loss of ecosystem services.

Impacts on soils

Although carbon storage in soils is related to changes in atmospheric CO₂ concentration, increased temperature and changing precipitation patterns, there is no strong evidence for an overall negative or positive impact on carbon storage. Climate change will increase erosion risks, especially in places where erosion is already severe. Landslides as a result of soil saturation with water from heavy rainfall and snow melt have mainly local effects in Europe, leading to loss of soil functions and increased vulnerability to erosion. Coastal erosion will also increase. Salinity of soils is expected to increase in coastal areas due to sea level rise.

Impacts on society and economy

Climate change increases the vulnerability of the European economy by threatening capital stocks, infrastructure and specific impacts on several economic sectors. Extreme events are likely to occur more often and may become more severe, leading to increased damage risks.

Impacts on infrastructure

As a result of extreme events (floods, heat waves, forest fires, storms, etc) especially energy, traffic and communication networks have an increasing risk of damages and disruptions.

Costs associated with monitoring and maintenance of these networks are likely to increase. Extreme events might also lead to transport restrictions. Flooded ports are not accessible and roads and railways can be blocked by floods and forest fires. The capacity of railways is limited by heat waves and traffic jams are more likely to occur during rainfall. Inland navigation will more often be faced with restrictions associated with extremely low and high river discharges. Changes in transport capacity may lead to changes in transport costs or to a shift between transport modalities. Economic impacts are closely related to the frequencies of damage-, disruption- and transport restriction events and the availability of transport alternatives.

Impacts on the energy sector

Energy production facilities that depend on the cooling function of rivers are doubly vulnerable: during a drought there is less water in rivers and their water temperature may be higher which restricts cooling water availability. For nuclear power plants a lack of cooling water may necessitate expensive shutdown events. Energy installations located in areas which are vulnerable to flooding should be built to withstand such effects. The prospect for renewables is affected by climate change in several ways. Low water flows affect hydropower. Biomass production will profit from higher temperatures in Northern Europe and will be limited in Southern Europe because of droughts. Human behaviour concerning energy use is altered by climate change. The demand for heating will go down and the demand for cooling goes up. In some places peak demand may shift from winter to summer.

Impacts on agriculture, forestry and fisheries

Climate change and climate variability affect agricultural production and farmer's income. Effects of climate change on local economies in Europe may be substantial. Climate change and variability differs throughout Europe and for different farming systems. In general higher temperatures seem to be an advantage for crop yields in Northern Europe, whereas higher temperatures and persistent dry periods during summer will limit crop production in southern Europe. Weather extremes associated with damages such as droughts and extreme rain fall are likely to occur more often. Climate change affects animal health, growth and reproduction. Increasing yield variability as a result of pests and diseases and severe storms is expected.

Impacts on forestry

Towards the end of the 21st century, severe and wide ranging negative climate change impacts on the forestry sector are expected in most European regions, with the Mediterranean region as the most vulnerable one to climate change. Forest fires are likely to dominate in southern Europe. The limited diversity of tree species in boreal forests enhances the risk of significant pest and disease impacts. Extreme storm events are likely to increase in north, west and central Europe, leading to economic losses. Rising temperatures and CO₂ concentrations on the other hand increase forest productivity in northern Europe.

Impacts on fisheries

Fisheries will be influenced by climate change because it leads to an increase in the uncertainty about the state of the fish stocks. To the fisheries industry a loss of fish productivity may lead to lost revenues and increased distances to fishing grounds.

Impacts on industry

The industrial sector is generally thought to be less vulnerable to the impacts of climate change. Still the industrial sector can be affected by extreme weather events such as storms and floods which could lead to considerable damage to industrial facilities and infrastructure. Transport routes are affected which especially affects perishable commodities. Significant rises in insurance costs are expected, especially in relation to extreme events. The likely effects of climate change on the tourism sector vary widely, depending on the location and the season.

Impacts on human health

Due to higher temperatures heat related deaths and air pollution are expected to have a big impact on the health of the European population by 2020. The impact by 2080 is more uncertain. This problem might be more severe in cities. Problems with allergens are expected to increase, which may lead to high medical costs. Further development of the European health care sector is important to reduce the risk of vector borne diseases. Extreme events such as fires, droughts and floods will have direct and indirect health effects in the affected area.

Impact on urban areas

Urban areas combine economic activities, high population rates, dense infrastructure and large amounts of capital stock. Therefore, many of the previously mentioned impacts can have a combined effect on a city. Economic and social impacts are potentially high. The most serious impacts seem firstly urban heat and air quality deterioration that combined can lead to higher number of deaths during heat waves; and secondly extreme events like flooding and disruption of power systems through wind storm damage. In coastal areas cities are vulnerable to coastal flooding, coastal erosion and salt water intrusion due to sea level rise.

1.5 Gaps identified in the selected policy areas

Key policy areas (Land-use and soil, agriculture, forestry, biodiversity and nature management, fisheries and aquaculture, freshwater resources, energy, infrastructure and transport, industry and services including tourism, health, coastal areas, and urban areas) relevant to or associated with the key impacts and main threats have been screened based

on legally relevant documents and reports to the policy areas. A cross-cutting section has been introduced since some documents have implications for various policy areas. From the results it came clear that water management takes current the strongest effort to incorporate adaptation to climate change, while other sectors such as energy or transport have not taken any or just little effort. Based on these findings the following sectors have been selected in coordination with the European Commission to be further investigated:

- Energy: low research and adaptation activities but medium to high estimated adaptation costs
- Infrastructure and transport: low research and adaptation activities but high estimated adaptation costs
- Urban areas, buildings and telecom: no/limited adaptation effort although high damage and adaptation costs to be expected.
- Agriculture: enough reliable data and information but support the current on-going process of policy formulation is needed as agriculture is one of the main drivers for land use, soil quality and water use.

1.5.1 Energy

The term ‘tackling climate change’ (or similar) is referred to in many regulations, directives and the two green papers on secure, sustainable and competitive energy and energy network. In fact, this refers solely to mitigation efforts, but not to responsive measures urgently needed to enhance climate change resilience for distribution and subsequently securing supply.

The urgent need to tackle climate adaptation becomes visible when looking at the yet most common (and most important in terms of share of the total energy supply) renewable energy sources: these are the completely climate dependant sources provided by wind, running water and solar irradiation.

1.5.2 Infrastructure and transport

Most existing transport policies do not explicitly address the climatic pressures (e.g. increase of temperature) and impacts which can be expected in the future as potentially harming transport infrastructure (cf. Altvater, et al, 2011a). However a few policy implementation reports (e.g. Fifth report on economic, social and territorial cohesion) have started to highlight the need for climate change adaptation of transport infrastructure. Further other policies include mechanism or technical standards which could be extended in regard to adaptation. In addition, adaptation can be integrated in existing policies dealing with new infrastructure projects (especially those who receive EU funding) to ensure climate-proofed infrastructure. Screening relevant policies for the different transport modes (rail, road, shipping, aviation) showed that not all mention the need to address climate change (e.g. in the Communication for Integrated Maritime Policy).

The few measures suggested are mostly support actions in the field of capacity building (e.g. increase of knowledge, improvement of data and accessibility to data). A few policies propose measures which are also of importance under the headline of climate change

adaptation (e.g. Directive on River Information Services to implement information services and to provide information on navigation, water level etc.)..

1.5.3 Urban areas

Existing policies related to **urban built environment and open spaces** do not explicitly address the climatic pressures (e.g. increase of temperature) and impacts which can be expected in the future as potentially harming urban built environment. Nevertheless, a few policies (e.g. floods directive) highlight the need to integrate possible impacts due to climate change into the respective plans (flood risk management plans). In addition, adaptation can be integrated in the revision of the currently developed plans, especially those who receive EU support for the plan developments or its realization (e.g. Cohesion funds) to ensure climate-proofed built urban environments.

Existing policies related to **urban buildings (including pole related construction)** do not explicitly address the climatic pressures (e.g. increase of temperature, storms, salt water intrusion) and expected future impacts. Nevertheless, a few policies (e.g. energy performance of buildings directive) highlight the need to focus on mitigation and the relation to the fulfillment of the Kyoto 2°C target. In addition, adaptation can be integrated in the Euro codes⁴ of buildings (Commission Recommendation on Euro codes⁵) as well as into the design of new urban development.

With regard to **communication infrastructure (incl. energy supply)** no explicit policies could be identified. Nevertheless, a few policies (e.g. transport, energy) highlight the need to integrate possible impacts due to climate change into the respective plans and projects. In addition, adaptation can be integrated in the revision of the currently developed plans and projects, especially those who receive EU support for its development or its realization (e.g. Cohesion funds) to ensure climate-proofed communication infrastructure.

Policies related to **human health and air quality** do not explicitly address the climatic pressures (e.g. increase of temperature, droughts) and impacts which can be expected in the future as potentially harming human health and air quality. Nevertheless, a few policies (e.g. air quality directive, Staff working document, accompanying the White Paper on Adaptation – Human, Animal and Plant Health Impacts of Climate Change⁶) highlight the need to integrate possible impacts due to climate change into the respective systems and plans (e.g. Heat Health Warning System, environmental health information systems, air quality plan and short term action plan). In addition, adaptation can be integrated in the revision of programmes, especially those who receive EU support for the project or initiative (e.g. EU Health Programme). (cf. 4 Exploration of adaptation options for the EU level).

Relating to **urban transport** existing policies do explicitly address climate change as impacts that will cause dramatic shifts in global eco-systems and urgent action is required to keep impacts to a manageable level. A few European initiatives (e.g. Green paper – Towards a

⁴ The Euro codes are a set of unified international codes of practice for designing buildings and civil engineering structures, which will eventually replace national codes.

⁵ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:332:0062:0063:en:PDF>.

⁶ http://ec.europa.eu/health/ph_threats/climate/docs/com_2009-147_en.pdf.

new culture for urban mobility and Communication “Action plan on urban mobility”⁷⁸) highlight the need to integrate possible impacts due to climate change into the respective urban transport modes and (e.g. urban mobility actions). In addition, adaptation can be integrated in the revision of programmes, especially those who receive EU support for the project or initiative (e.g. CIVITAS Initiative⁹) and recommendations (e.g. Europe at a crossroads – The need for sustainable transport¹⁰).

1.5.4 Agriculture

The Commission staff working document **"The role of European agriculture in climate change mitigation"**¹¹ concentrates on greenhouse gas emissions and trends in agriculture in the EU and possibilities for reducing them. It also gives an overview of the current instruments of the CAP that facilitate climate change mitigation, examining in particular how the rural development programmes for 2007-2013 contribute to this objective.result from climate pressures. The Document outlines the following adaptation measures on the farm level:

- 1 Adjusting the timing of farm operations, such as planting or sowing dates and treatments;
- 2 Technical solutions, such as protecting orchards from frost damage or improving ventilation and cooling systems in animal shelters;
- 3 Choosing crops and varieties better adapted to the expected length of the growing season and water availability, and more resistant to new conditions of temperature and humidity;
- 4 Adapting crops with the help of existing genetic diversity and new possibilities offered by biotechnology;
- 5 Improving the effectiveness of pest and disease control through for instance better monitoring, diversified crop rotations, or integrated pest management methods;
- 6 Using water more efficiently by reducing water losses, improving irrigation practices, and recycling or storing water;
- 7 Improving soil management by increasing water retention to conserve soil moisture, and landscape management, such as maintaining landscape features providing shelter to livestock;
- 8 Introducing more heat-tolerant livestock breeds and adapting diet patterns of animals under heat stress conditions.

⁷ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2009:0490:FIN:EN:PDF>.

⁸ http://ec.europa.eu/transport/urban/urban_mobility/doc/2009_apum_citizens_summary_en.pdf.

⁹ <http://www.civitas-initiative.eu/main.phtml?lan=en>.

¹⁰ <http://ec.europa.eu/publications/booklets/move/39/en.pdf>.

¹¹ See http://ec.europa.eu/agriculture/climate_change/workdoc2009_en.pdf.

9 Building adaptive capacity by awareness raising and provision of salient information and advice on farm management,

The current CAP has already included some of these measures (Measures number 2, 6, 7, 9) in its Rural Development Program (RD) which is also known as pillar two. Nevertheless the current RD measures allows including a much wider set of measures that facilitate adaptation to climate change. Some of these measures are already applied in some MS, but could clearly expanded.

Under the first Pillar which deals with direct support to farmers, adaptation is not an issue.

Sector specific recommendations

Mainstreaming adaptation into existing EU policies aims to ensure that the chosen policy areas are able to better cope with current and future major threats identified in task 1 and further refined in task 2.1. The recommended actions can be divided into 2 main activities:

- Adjusting existing sectoral policies. Amendments of existing policies or new legislation will mainly be triggered by other purposes than mainstreaming climate change. Nevertheless, all major EU policy initiatives and legislative proposals have to undergo an impact assessment. The Commission guidelines for carrying out impact assessments (EC, 2009) are, for the analysis of environmental impacts, requiring considerations on the climate and in particular whether the option assessed affects the ability to adapt to climate change. Thus, the impact assessment procedure is seen as an important instrument to assure mainstreaming adaptation. Not all policy initiatives and legislative proposals are subject to an impact assessment though; the precise scope of application is decided on an annual basis and is published as roadmap together with the Commission's Annual Legislative and Work Programme (CLWP). It would be advisable that the underlying screening criteria for deciding on the scope of applying an impact assessment already take into account the aspect of climate change both in terms of mitigation and adaptation. For the latter the principle suitability of the policy in terms of strengthening climate change resilience should be considered.
- Proposing concrete technical adaptation measures. In the context of this study only few technical adaptation measures have been assessed in terms of costs and impacts within this study.

1.6 Energy

1.6.1 Possibilities to adjust existing energy policies

Major threats to the security of energy (esp. electricity) supply (Altvater, et al, 2011b) requiring short-term action can be aggregated to

- Direct threats to energy supply and distribution infrastructure mainly through extreme meteorological events/periods
- Future gaps in base load capacity if no measures are taken to climate-proof also regenerative energy supply that is expected to raise according to the 20/20/20 goals
- Increasing electricity demand peaks mainly during summer heat
- Overheating of thermal and nuclear power stations

Considering the current policy short comings set out in chapter 3, the following adaptation policy options are proposed:

Demand-side

- **DIRECTIVE 2010/31 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 17 May 2010 on the energy performance of buildings and its amendments**¹²

Directive 2010/31 aims at a at more energy efficiency of buildings. An increase in the energy efficiency shall contribute significantly to the 20/20/20 goals of the European Union, but would also add to the resilience of energy demand under future more variable climatic conditions: the according energy supply of the directly weather/climate-dependant renewable energy sources (water, wind and solar) as well as the temperature and (cooling) water availability-dependant vulnerable energy supplies by thermal power stations.

Article (6): New buildings

1. Member States shall take the necessary measures to ensure that new buildings meet the minimum energy performance requirements set in accordance with Article 4.

For new buildings, Member States shall ensure that, before construction starts, the technical, environmental and economic feasibility of high-efficiency alternative systems such as those listed below, if available, is considered and taken into account:

- (a) De-centralized energy supply systems based on energy from renewable sources;
- (b) Co-generation;
- (c) District or block heating or cooling, particularly where it is based entirely or partially on energy from renewable sources;
- (d) Heat pumps.

Suggestion: Add: “(e) ‘solar cooling’ i.e. air conditioning powered by onsite PV”

- **REGULATION (EC) No 106/2008 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 15 January 2008 on a Community energy-efficiency labelling programme for office equipment (Energy Star)**¹³

Regulation 106/2008 shall contribute to the 20/20/20 targets of the European Union, but would also decrease the risk of black-outs during demand peaks and thus increase resilience in the energy sector..

Suggestion: Add: “air conditioning devices” and “solar cooling” in the annex c for office equipment product groups

Supply-side (Thermal power generation)

- **REGULATION (EC) No 663/2009 establishing a programme to aid economic recovery by granting Community financial assistance to projects in the field of energy**¹⁴

Regulation 663/2009 is dedicated to help economies to recover from the economic downturn in 2008. However, this effort should be used to modernize the energy infrastructure in the EU

¹² <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:153:0013:0035:EN:PDF>.

¹³ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:039:0001:01:en:HTML>.

¹⁴ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:200:0031:0045:EN:PDF>.

also by incorporating the explicit goal to raise resilience towards climate change and extreme events.

Article 8: Selection and award criteria under (2)

Suggestion: Add: (i) the capability to increase the climate resilience of the energy supply system through climate-proofing renewable energy as well as thermal power plants and by introducing water saving technologies especially for the cooling purposes of thermal power plants (incl. nuclear).

Transmission and distribution

- **Directive 2009/72/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in electricity**¹⁵

Directive 2009/72/EC shall contribute to create a common energy market with EU-wide competition of energy suppliers. However, this task should go hand in hand with the creation of resilient grid properties that can be supported by stronger inter-linkage of national grids towards a (still visionary) pan-European grid infrastructure.

Art. 12 (c): Tasks of transmission system operators:

“Each transmission system operator shall be responsible for:

contributing to security of supply through adequate transmission capacity and system reliability”

Suggestion: Add: “For the latter, risks posed by climate change for the existing network components shall be taken into account, in particular towards meteorological extreme events including associated mass movements.”

- **Directive 2005/89/EC of the European Parliament and of the Council of 18 January 2006 concerning measures to safeguard security of electricity supply and infrastructure investment**¹⁶

Directive 2005/89/EC has the goal to assure stable investments to the electricity network infrastructure to safeguard its maintenance and additional demands that put on it.

(15) „Transmission and distribution system operators need an appropriate and stable regulatory framework for investment, and for maintenance and renewal of the networks.”

Suggestion: Add [...]“while additional stresses are put on the TSO by climate change, which are

- a. Direct impacts onto the network via increasing temperatures and more extreme events
- b. Different demand patterns induced by more frequent heat waves
- c. Higher share of renewable energy putting more volatility on the network.”

Art. 6,1. “Member States shall establish a regulatory framework that:

(a) Provides investment signals for both the transmission and

¹⁵ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:211:0055:0093:EN:PDF>.

¹⁶ http://www.energy.eu/directives/l_03320060204en00220027.pdf.

distribution system network operators to develop their networks in order to meet foreseeable demand from the market; and
(b) Facilitates maintenance and, where necessary, renewal of their networks.”

Suggestion: Add: “(c) allows TSOs and DSOs to enhance climate resilience of their infrastructure especially towards projected more frequent and intense extreme events.”

- **Regulation (EC) No 67/2010 of the European Parliament and of the Council of 30 November 2009 laying down general rules for the granting of Community financial aid in the field of trans-European networks**¹⁷

Regulation 67/2010 lays down rules to be applied for granting investments of TSOs/DSOs in the TEN-E infrastructure. While for most of these investments construction of physical grid infrastructure will be necessary, an incorporation of climate risks to these high-cost investments is needed.

Art. 6.4: “Project selection criteria”

“The decision to grant Community aid should also take account of:

- (a) The maturity of the project;
- (b) The stimulative effect of community intervention on public and private finance;
- (c) The soundness of the financial package;
- (d) Direct or indirect socio-economic effects, in particular on employment;
- (e) The environmental consequences.”

Suggestion: Add: “(f) the risks of damages to the project by climate change impacts.”

1.6.2 Assessment of potential technical measures in the energy sector

To be able to cope with these climate change threats, the following technical measures have been selected for further assessment¹⁸:

- Adaptation of electricity grids in EU26 (without Malta)
- Additional cooling of thermal power plants in EU27
- Early warning system for extreme weather events for one power plant
- High efficiency ventilation in 2025

Table 1 summarizes the key findings of the estimated costs for key adaptation measures for the energy sector. The figures have been estimated by transferring results of bottom-up studies to the European level using numerous case studies, expert information and databases. The results are subject to various assumptions and constraints described in the respective chapters of Task 2.2 report (Altvater, et al 2011b).

¹⁷ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:027:0020:0032:EN:PDF>.

¹⁸ For further adaptation measures and corresponding policy options please refer to the task 2 report.

Table 4-1: Summary of cost estimates for key adaptation measures in the energy sector

Adaptation option	Total costs			
Adaptation of electricity grids in EU26 (without Malta) (in million € p.a.)	654.1 (A1FI)			
	636.6 (B1)			
Additional cooling of thermal power plants in EU 27 (in million € p.a.)	637.3			
Early warning system for extreme weather events for one power plant	Annual investment costs		Annual operating costs	
	Worst case	Best case	Worst case	Best case
	43,200 €	15,200 €	45,420 €	22,810 €
High efficiency ventilation in 2025 (in € p.a.)	100 million to 41.8 billion			

The adaptation measures in the energy sector (especially electricity infrastructure) show a high relevance and are considered as a need-to-have adaptation option, because the energy transmission and distribution networks are part of the critical infrastructure. The urgency of the adaptation measure is high due to the long lifetime of the electricity transmission and distribution infrastructure (50-100 years). Climate-proofing of the electricity networks can only be achieved in a cost-effective way if it is integrated into this overhaul and expansion; a retrofitting of existing infrastructure would be significantly more expensive. With the combination of the expansion and climate-proofing, economic side effects are limited. A demand for adapted electricity grids and more efficient electricity equipment, i.e. cooling facilities, is expected, so it can help to promote the diffusion of European technologies. The investment need in this sector would have also a positive impact on small and medium enterprises (SMEs). The Environmental side effects occur mostly during the construction work for overhead lines, for underground cables, cooling facilities of power plants, etc. Furthermore, the measures which have the objective to reduce the energy use, i.e. more efficient cooling facilities, have positive side-effects on the reduction of greenhouse gas emissions. Social effects are low, effects on well-being are limited, especially if infrastructure corridors are used for new electricity lines, i.e. railway tracks, roads.

The benefit of the measures is estimated on the basis of statistical data and existing case studies or research reports. A transfer of data, i.e. from UK data, to other countries was necessary, and due to the uncertainty of climate projections a value range was estimated.

The calculation of for strengthening transmission and distribution lines is based on power outages because of extreme storm events. The benefits for EU26¹⁹ are estimated at € 130

¹⁹ EU27 without Malta.

million to € 6,500 million per year, with a best-guess estimate of € 870 million per year. Especially high benefits are estimated for countries with a high percentage of energy use in the industry sector. Compared to the estimated costs in Task 2 (some € 500 to 650 million per year) it seems more likely that the benefits exceed the costs than that the opposite is true. But lower level of benefits are lower than the lower-end of the costs, the costs can be higher than the estimated benefits. There is a high potential for benefits and already the average benefit exceed the costs much.

More efficient ventilation systems show a benefit via reduced electricity consumption. The savings for the consumers are estimated from 8.5 to 66.6 billion Euro per year for EU-27. The benefit-cost-ratio is positive for the most scenarios (costs estimated with a value of 100 million and 41.8 billion Euro per year). But if the costs tend to the higher value of 41.8 billion also a negative ratio is possible, also dependent on the actual impacts reasoned by climate change. The lower-end of the costs is much lower than the lowest benefits, and the benefits can exceed the costs with a huge amount. However, all estimates depend on a number of assumptions, i.e. current electricity prices, uncertainty on the projected increase in efficiency.

1.7 Transport infrastructure

1.7.1 Possibilities to adjust existing infrastructure and transport policies

Major threats to the transport infrastructure requiring short-term action can be aggregated to:

- summer heat, especially in South Europe, e.g. leading to track buckling, material fatigue, pavement subsidence, etc.
- extreme precipitation which can be expected European wide, e.g. leading to road submersion, scour to structures, etc.

Having these threats in mind and considering the long-term investments - with a life-span-time up to 100 years (e.g. major transport routes, bridges, tunnels) – it is important to take climate change into account already today. Due to the uncertainties in future climate projections, planning new infrastructure should not focus on one single “optimal” solution but should be made more robust to a range of possible climatic changes (Hallegatte 2007). Dessai et al. 2009 states that “robust strategies” perform well (though not necessarily optimally) over a wide range of assumptions about the future.

Account also needs to be taken of the network nature of the transport system. Different elements of the transport infrastructure have varying level of importance for the overall functioning of the transport system: a major hub plays a crucial role in the whole of the aviation network, while a small regional airport not. The ash cloud crisis in April 2010 and the weather-related disruptions towards the end of 2010 have shown that the capacity of the EU transportation system to tolerate and absorb disruption triggered by natural or man-made disasters is not sufficient to meet its basic function, which is to ensure a seamless mobility of people and goods. The lessons drawn suggest that, besides obstacles of a more structural nature such as missing links in the transport network and the lack of Single Transport Area, the vulnerability of the EU transport system can be attributed to the inadequate level of preparedness and cooperation between all actors (COM 2011:73 144 final). These lessons learned are also important in regard to enhance the climate change resilience of the transport system.

Thus, in the case of transport infrastructure, multiple-benefits, no-regret and low-regret adaptation options²⁰ should be favoured with focus on main transport nodes and corridors.

Considering the current policy shortcomings set out in chapter 3, the following adaptation policy options are proposed:

All transport modes

- **TEN-T Guidelines (661/2010/EC)**^{21,22}

The TEN-T aims to establish a single, multimodal network that integrates land, sea and air transport networks throughout the EU. The guidelines shall provide a framework for the identification of projects of common interest and they shall set out instruments for the implementation of such projects.

Mainstreaming adaptation into the TEN-T guidelines is of high priority as this would ensure that new trans-European transport infrastructure is climate-proofed and thus resilient to a changing climate.

Suggestion 1: Include in objectives of trans-European transport network, that the network is resilient to a changing climate.

Suggestion 2: Technical measures such as improved material able to cope with higher temperature, improved conditioning systems, retrofitting drainage systems, early warning systems etc. (corresponding to all key adaptation measures identified) should be taken into account in technical harmonization for all transport modes.

Rail

- **Directive 2008/57/EC on the interoperability of the rail system within the Community**²³

This Directive sets out to establish the conditions to be met to achieve interoperability within the Community rail system. These conditions concern the design, construction, placing in service, upgrading, renewal, operation and maintenance of the parts of this system as well as the professional qualifications and health and safety conditions of the staff who contribute to its operation and maintenance.

Technical Specifications for interoperability

²⁴

²⁰ Multiple-benefits options provide synergies with other goals such as mitigation or sustainability; No-regret and low-regret actions are beneficial in all plausible climate futures, such as early warning systems and insurance against floods.

²¹ http://ec.europa.eu/transport/infrastructure/basis_networks/guidelines/guidelines_en.htm.

²² <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32010D0661:EN:NOT>.

²³ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:191:0001:0045:EN:PDF>.

²⁴ <http://www.era.europa.eu/CORE-ACTIVITIES/INTEROPERABILITY/Pages/TechnicalSpecifications.aspx>.

Technical specifications for interoperability (TSIs) mean the specifications by which each subsystem or part of subsystem is covered in order to meet the essential requirements and to ensure the interoperability of the trans-European high speed and conventional rail systems. The European Railway Agency works on drafting the third group of Conventional Rail Technical Specifications for Interoperability concerning Infrastructure, Energy, Locomotives and Passenger rolling stock, and Telematic applications for passenger services. The Agency is also carrying out the revision of TSIs related to Freight wagons, Operation and traffic management, and Noise. Further activities will include revision of earlier adopted TSIs with the aim of extending their scope to the entire European railway network.

Suggestion: Include aspects of climate change regarding higher temperature (and increased precipitation in the development or revision process of TSIs).

Road

- **Directive 2008/96/EC on road infrastructure safety management**²⁵

This Directive requires the establishment and implementation of procedures relating to road safety impact assessments, road safety audits, the management of road network safety and safety inspections by the Member States for the trans-European road network, whether they are at the design stage, under construction or in operation.

Suggestion: When carrying out a road safety impact assessment and road safety audits for infrastructure projects, not only the current climatic conditions should be taken into account, but also information on possible future climatic conditions. Thereby adapting new infrastructure regarding increased temperature and precipitation should be ensured.

Aviation

- **Council Regulation (EEC) No 3922/91 on the harmonization of technical requirements and administrative procedures in the field of civil aviation**²⁶

This regulation applies to the harmonization within the European Union (EU) of technical requirements and administrative procedures in the field of civil aviation safety, concerning the operation and maintenance of aircraft and to persons and organisations involved in those tasks.

Suggestion: The EC, assisted by the European Air Safety Agency, shall consider amending the common technical requirements and administrative procedures where such amendments seem necessary by new information from science and technology. The European Air Safety Agency can play a crucial role for the generation of new knowledge on climatic risks and possible adaptation responses as well as for the dissemination, providing evidence base for adjustments of existing technical requirements or administrative procedures in terms of adaptation to climate change.

²⁵ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:319:0059:0067:EN:PDF>.

²⁶ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31991R3922:EN:HTML>.

Shipping

- **Directive 2005/44/EC on harmonized river information services (RIS) on inland waterways in the Community & Commission Regulation (EC) No 414/2007 concerning the technical guidelines for the planning, implementation and operational use of river information services**

The River Information Services (RIS) concept is aimed at the implementation of information services in order to support the planning and management of traffic and transport operations. The Directive aims at a Europe-wide framework for the implementation of the RIS concept in order to ensure compatibility and interoperability between current and new RIS systems at European level and to achieve effective interaction between different information services on waterways. In order to ensure harmonized and interoperable implementation of RIS, guidelines and technical specifications were established in 2007.

Suggestion: Some of the information provided within RIS is also important in regard to adaptation to climate change (e.g. fairway information, navigation support, transport logistic). Nevertheless, the current version of the RIS Guideline does not touch upon the issue of climate change. Thus, when updating the RIS Guidelines, the existing system should be analysed also with a view to possible impacts of climate change and – if necessary – revised to be climate proofed.

1.7.2 Assessment of potential technical measures in the infrastructure and transport sector

To be able to cope with these climate change threats, the following key adaptation measures have been selected for further assessment²⁷.

- Adapting tracks to higher temperatures in the EU
- Adapting roads to higher temperatures in the EU
- Adapting roads to increase in precipitation in the EU
- Better surface asphalt for European runways
- Retrofitting existing infrastructure of airports' drainage system to increase of wet days
- Installation of additional hydrological stations
- Riverine floods early warning systems

Assessment of potential technical measures in the infrastructure and transport sector Table 2 below provides the cost estimates for key adaptation measures in the transport sector. The methods, assumptions and limitations made in the different cost estimates are explained in the specific sections of Task 2.2 report (Altvater, et al, 2011b) . The calculations are based upon numerous case studies, top-down studies for the transport sector, databases and surveys, expert interviews and own assumptions. Therefore the uncertainties about the assumptions are high. The costs might be lower because it is difficult to separate pure climate change adaptation measures from adjustments to an increased volume of traffic.

²⁷ For further adaptation measures and corresponding policy options please refer to the task 2 report.

Table 4-2: Summary of cost estimates for key adaptation measures in the transport sector

Adaptation Option	Total Costs (if not indicated differently, in million € p.a.)		
Adapting tracks to higher temperatures in the EU	Average Cost of Delay Minute 24.14 € (Enei et al., 2011)	Average Cost of Delay Minute 72.28 € (Eddowes, 2003)	Average Cost of Delay Minute 107.39 € (Burr, 2008)
	58.6	175.5	260.7
Adapting roads to higher temperatures in the EU	Min		Max
	2,973		8,918
Adapting roads to increase in precipitation in the EU	100% increase of drainage capacity	50% increase of drainage capacity	20% increase of drainage capacity
	139.6	69.8	27.9
Better surface asphalt for European runways	Min		Max
	142.8		428.2
Retrofitting existing infrastructure of airports' drainage system to increase of wet days	100% increase of drainage capacity	50% increase of drainage capacity	20% increase of drainage capacity
	181.6	90.8	36.3
Installation of additional hydrological stations	One-time		Annual
	20.9		2.6
Installation of additional hydrological stations concerning flood damages of all sectors	Control Scenario		
	One-time		Annual
	25.5		3.2
	A2 Scenario		
One-time		Annual	

	27.5	3.4
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Due to a critical infrastructure, the measures meet a high public interest although the autonomous adaptation and windfall profits seem to be low due to mostly public financing of transport infrastructure. The urgency is short -to medium-term. Due to the size of transportation networks activities should begin as soon as possible. Furthermore, it is recommend that measures should be integrated in the reinvestment cycle.

For all measures the reduction of greenhouse gas emissions can be considered as a positive environmental side effect. Especially, on roads the detour of vehicles lead to higher emissions, but also detoured airplanes and trains show a higher amount of greenhouse gas emissions. Furthermore, other emissions like noise, other air emissions due to detours can be reduced. A large environmental impact shows the construction work, with consequences on biodiversity, etc. Through the inclusion in the reinvestment cycle no significant additional effects occur. Only low social effects exist. The well-being can be increased through a lower waiting or driving time on road, in railway, so a higher amount of leisure time is the consequence. The positive effects are especially significant for people who travel more, but also freight is transported, so all inhabitants benefit from the measures.

The benefits for the avoidance of railway track buckling due to increased temperature are calculated with 90 million to 537 million Euro per year. The benefits will accrue to railway companies in the first instance, since they would have to pay for the repair of equipment / rolling stock and tracks. Obviously, such benefits would also accrue to customers in the form of lower ticket prices at a small amount, provided that benefits are passed on to consumers. The costs for track buckling in the form of costs of speed restriction which could prevent derailments are estimated between: 59 million and 260 million Euro per year for EU 27 according to different values for delay minutes. The benefits can exceed the costs. But with a high amount of costs and low benefits also a negative benefit-cost ratio is possible.

For heat-resistant asphalt on road network the benefits are estimated between 1.9 and 2.5bn Euro per year for passenger travel and approximately 183 million Euro per year for freight transport. The amounts only include the value of time savings from avoided detours and delays. The avoided cost for repair and maintenance, and the avoided cost of accidents are not included. It can be assumed that the total benefit will exceed the calculated amount significantly. The comparison of different road types shows that the larger share of benefits is realised by retrofitting motorways with heat resistant asphalt. This result reflects both the facts that passengers travel on motorways, and the longer duration of detour for motorways. The costs for better heat-resistant asphalt are between 2,9 and 8,9 bn Euro per year. The benefits-cost-comparison implies that, if the costs are at the lower end of the estimated range, benefits and costs would be almost equal. It is more likely though that the costs of the measure would exceed the estimated benefits. Like already mentioned, the estimated benefits only measure the benefits of avoided delays and detours in terms of saved travel time. If more benefit components are included it can be assumed that the benefits reach the mid-range of the costs.

The costs for better drainage systems with a higher capacity are between 50 and 240 million Euro per year. The highest costs are assessed for France, Germany and United Kingdom.

The benefits for drainage systems with a higher capacity on roads are estimated between 17 and 53 million Euro per year for passenger travel and 1.7 to 4.1 million Euro per year for freight transport. It should be kept in mind that, the estimation quantified some of the benefits of the described measure (cost of avoided traffic disruptions in the form of detours and delays), but did not assess e.g. the avoided cost of maintenance and repair, or avoided the cost of accidents. From the estimated result the highest benefit would be observed in Germany, followed by the United Kingdom and France. In line with the projections for the increase in precipitation, Northern Europe tends to be more affected.

There is no guarantee that the benefits of the measure will exceed its costs. If the benefits are at the upper end of the estimated range, and the costs at the lower end, there is a chance that the measure will deliver a net benefit. If the costs are at the upper end of the estimated range, they will exceed the benefits – at least that share of the benefits that was quantified above.

The estimations show a significant uncertainty, especially because of the missing data, but also due to assumptions, for instance on the distribution of passengers to different road types and the detour duration. The uncertainty of climate projection also has an influence on the accuracy of the estimated values.

1.8 Urban areas

1.8.1 Possibilities to adjust existing urban areas policies

Major threats to Urban Areas (cf. more details task 2-report) requiring short-term action can be aggregated to

- Temperature increase and heat waves, an increase of the heat island effect, decrease of comfort in buildings; interruption, damage and increase of maintenance costs of communication infrastructure. Additionally, this might lead to impacts on health (vector born diseases), worsening of air quality. Water scarcity and drought might lead to water borne diseases (decrease of water quality) as well as a lack of water in quantity and quality, water supply, urban waste water treatment and water efficiency
- Floods and heavy precipitation events might lead to the damage of infrastructure, loss of property due to location (e.g. infiltration of water into buildings), heavy water run-off causing interruptions, damages and increase of maintenance costs of e.g. communication infrastructure
- Storms and winds might lead to interruptions, damage and increase in maintenance costs

Policies able to accommodate those key measures and having a high mainstreaming potential (and thus a relatively quick and easy implementation) are proposed and described below in further detail:

Green spaces

- **Future cities**

Between 2007 and 2013, around €30 billion are spent on urban projects within region policy programmes. In addition to the policy's financing for infrastructure and people-based actions, the European Territorial Cooperation objective (formerly "INTERREG") can be used by cities

to develop joint cross-border or transnational projects. The Commission also provides special support for cities to work together through the URBACT programme, which is a European exchange and learning programme promoting sustainable urban development. In the current programming period URBACT offered financial support to 289 cities participating in 44 different projects. The programme enables cities to jointly develop solutions to major urban challenges, reaffirming the key role they play in facing increasingly complex societal changes.

Current regional funding programmes will run until 2013. Options for cohesion policy after 2014 are already being discussed. This discussion is linked to the broader context of the EU budget²⁸ and the Europe 2020 strategy²⁹.

The Fifth Cohesion Report³⁰, adopted in November 2010, set out ideas on how cohesion policy might be reformed, including:

- focusing resources on a few priorities closely linked to the Europe 2020 strategy
- defining clear and measurable targets
- strengthening regulatory and institutional frameworks
- conditionality and incentives
- increasing the leverage effect of investments
- private sector finance
- simplification of the management rules
- concentrating on the poorest Member States and regions

Suggestion: Concrete formulation of adaptation needs into the future cohesion policy, which shall be, *inter alia*, stronger focusing on the urban dimension. Only measures like green and grey infrastructures that improve the resilience of urban areas against impacts of a changing climate shall be funded in the upcoming Cohesion Fund (COM 2006). Like suggested in the orientation paper on future Cohesion Policy³¹, Cohesion policy investments should be climate proofed. Competitiveness measures will need to take into account constraints and opportunities of a low carbon economy.

Green Roofs

- **Future cities**

See above.

²⁸ http://ec.europa.eu/budget/biblio/documents/fin_fw1420/fin_fw1420_en.cfm.

²⁹ http://ec.europa.eu/europe2020/index_en.htm.

³⁰ http://ec.europa.eu/regional_policy/sources/docoffic/official/reports/cohesion5/index_en.cfm.

³¹ http://ec.europa.eu/regional_policy/newsroom/pdf/pawel_samecki_orientation_paper.pdf.

Suggestion: Concrete formulation of adaptation needs of buildings (e.g. green roofs) into the future cohesion policy, which will be stronger focusing on the urban dimension. The proponent of a building plan or any development needs to verify that the project is climate proof in order to receive support by the Cohesion Fund (COM 2006). This can be conducted e.g. by a brief climate assessment as a part of the building approval.

- **EU Energy performance of Buildings Directive (2010/31/EU)³²**

This Directive promotes the improvement of the energy performance of buildings within the Union, taking into account outdoor climatic and local conditions, as well as indoor climate requirements and cost-effectiveness. It lays down requirements for calculating the integrated energy performance of buildings and building units and the application of minimum requirements to the energy performance of new and existing buildings. These requirements are minimum requirements and shall not prevent any Member State from maintaining or introducing more stringent measures.

p9 (Art 8.1): technical building systems: adjustment and improvement of technical building systems like heating-, hot water-, air-conditioning- and cooling systems or as combination of such systems

p9 (Art 9.1): development of national plans for increasing the number of nearly zero-energy buildings

Suggestion: Concrete formulation of adaptation needs of buildings into the Energy performance of buildings Directive, which will be an important factor to adapt successfully and create synergies between adaptation and mitigation efforts. Methodologies and guidelines for climate proofing buildings could be incorporated into the national plans for increasing the number of nearly zero-energy buildings and green roofs. A preliminary climate proof check needs to be performed, in order to get an approval of a building project.

- **COMMISSION RECOMMENDATION (2003): on the implementation and use of Eurocodes for construction works and structural construction products, C(2003) 4639), (2003/887/EC)³³**

The recommendations call on Member States to adopt the Euro codes as a suitable tool for designing construction works, checking the mechanical resistance of components, or checking the stability of structures.

Suggestion: Concrete formulation of integration of adaptation into Euro codes for buildings. The building foundations need to be designed for the lifetime of a building, taking into account temperature increase, changed precipitation patterns and strong winds and storms. Additional green roofs have to be considered as a future standard for flat roofs.

³² <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:153:0013:0035:EN:PDF>.

³³ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:332:0062:0063:en:PDF>.

1.8.2 Assessment of potential technical measures in the urban sector

Green roofs and green space are two measures which can contribute to better management of climate change impacts in urban areas according to task 2.3. It is important to have measures in this area, especially concerning health impacts during heat waves. More measures exist, which can reduce the heat effect and can support the water management during rainfall, but the “green infrastructure” measure have the advantage of many additional positive side-effects. For the measures a high risk of windfall profit is discussed, as the measures appear profitable anyway. Urgency is seen as short- to medium-term. Nowadays, heat waves are already problematic and gradual increase is foreseeable. Furthermore, the measure “green roof” is effective immediately, also technologies are available. Other adaptation measures in urban areas like green space need a longer implementation time due to long planning processes. Both measures are limited by the available capacities. The measures are no-regret, because of their many environmental and social side effects. Green roofs and green space appear more economical even in the absence of climate effects. Higher investment and maintenance costs occur, but longer life expectancy of green roofs is discussed.

Table 3 summarizes the estimated adaptation costs for key adaptation measures. The figures have been estimated by transferring results of bottom-up studies to the European level using numerous case studies, expert information and databases. The results are subject to various assumptions and constraints described in the respective chapters of the Task 2.2 report. In particular it should be kept in mind that these costs refer only to the 323 large cities which are included in the Eurostat Urban Audit database. However, we consider this sample as a very good representation of urban areas in Europe. Moreover, to the best of our knowledge this was the first attempt of estimating Europe-wide costs of urban adaptation measures, which means that the uncertainties regarding the modeling of adaptation as well as the definition and transfer of unit costs are very high.

Table 4-3: Summary of cost estimates for key adaptation measures in urban areas

Adaptation option	Total costs in the EU27	
Green spaces	For all cities which provide sufficient data (111 of 323 cities)	Very rough estimation for all 323 cities in Urban Audit database
	2.6 billion € p.a.	more than 7.5 billion € p.a.
Green roofs	For all cities which provide sufficient data (240 of 323 cities)	Rough estimation for all 323 cities in Urban Audit database
	One-time investment: 5.2 billion € Maintenance: 80 million € p.a.	One-time investment: 7 billion € Maintenance: 100 million € p.a.

Environmental side effects exit with the avoidance of heat island which leads to reduction of electricity consumptions for cooling in buildings. Especially, green space but also green

roofs, have positive effects to the biological diversity in cities. Green infrastructure brings also benefits for improving air quality. Green space in urban areas has a substantial social impact on the well being of residents through their recreational functions and improved aesthetics. The measure benefits vulnerable groups (elderly, infants) and groups in urban areas with high population density. But No specific “losers” can be named. A stakeholder involvement is absolutely essential. Acceptance for such projects differ always locally. For green roofs the acceptance is currently mixed.

Costs for green space are calculated at 2.6 bn per year for about 100 European cities (for 58 were vulnerable and data was accessible). The total benefit through avoided deaths is estimated to be between 12.4 and 40 million Euro per year. Green space accounts for an estimated additional economic value of between 19,000 and 1.9 million Euro (for the 58 cities). The benefits include here only the avoided deaths and an increased economic value for cities’ parts near to green space. Other positive effects like higher recreation values are not calculated, due to missing serious data for recreation value of green space in cities. Lower health costs are not included, too. Through green space more positive effects are expected for climate change impacts on biodiversity and water management.

1.9 Agriculture

On 12 October 2011 the Commission presented a set of legal proposals designed to make the CAP a more effective policy for a more competitive and sustainable agriculture and vibrant rural areas. This proposal has been analysed as regards to adaptation towards climate change. A specific focus has also been put on the issue of water as it is a central issue for adaptation. Water is used by all key sectors (agriculture, transport, energy, urban) and is also most important for ecosystems and biodiversity.

1.9.1 Overall Budget

In commitment terms, the proposal allocates €281.8 billion for Pillar 1 of the CAP and €89.9 billion for Pillar 2 of the CAP (representing 76% and 24% of the total CAP budget, respectively). However the final split between both pillars will depend on the MS as modulation and revised modulation is possible. Overall, the CAP share of total budget commitments would be 36% (42% in the current 2007-2013 MFF).

1.9.2 Proposal for a regulation of the European Parliament and of the council establishing rules for direct payments to farmers under support schemes within the framework of the common agricultural policy

General Remark

According to the proposal small farmers have the possibility to apply for a specific scheme (TITLE V- Small farmers scheme). Being part of these scheme small farmers are exempted from the cross compliance, greening and control obligations. The regulation does not provide

a definition of what is a small farmer but according to previous discussion and approaches³⁴ the definition is most likely to be linked to income from farming and not directly linked to area that is utilised. Because of lack of this definition it is difficult (and was not possible in the time given to prepare this note) to assess how many hectares of UAA in the EU could be affected by this new scheme and how the areas will be distributed across the EU. However there is the risk that in several areas which face water problems might fall under this new scheme and water related problems might increase. **There is an urgent need to investigate this issue more detailed and identify if any potential risk areas!**

Table 4-4 Specific remark

Article of the regulation	Water	Climate
Art 14 (1) - flexibility between pillars: Before 1 August 2013, Member States may decide to make available as additional support for measures under rural development programming financed under the EAFRD up to 10 % of their annual national ceilings for calendar years 2014 to 2019 as set out in Annex II to this Regulation.	Can have a positive impact on water management depending on the overall design of the EAFRD (measures offered) in each MS. See assessment of the EFRAD regulation below.	Can have a positive impact on adaptation for climate change depending on the overall design of the EAFRD (measures offered) in each MS. See assessment of the EFRAD regulation below.
Art 14 (2) - flexibility between pillars: Before 1 August 2013, Bulgaria, Estonia, Finland, Latvia, Lithuania, Poland, Portugal, Romania, Slovakia, Spain, Sweden and the United-Kingdom may decide to make available as direct payments under this Regulation up to 5 % of the amount allocated to support for measures under rural development programming financed under the EAFRD in the period 2015-2020	This is new compared to previous reforms and may move money away from targeted spending. This is in particular important as the MS listed have already important water problems (diffuse pollution or water scarcity) or are currently having an extensive agricultural production, which might intensify due to these payments. Also existing intensive structures might be maintained or further intensified.	This goes against all previous reforms and moves money away from targeted spending, reducing the options for adaptation. There is the risk of mal-adaptation as farming will remain/intensified in areas which will be not suitable to be so in the future.
Chapter 2 (Art 30- Art 33): payments for agricultural practices for the climate and the environment.	30% of the direct payments will be so called green payments (crop diversification, permanent grassland and ecological focus area).	
	Compared to the Communication the "Green cover" was not considered in	Compared to the Communication the "Green cover" was not considered in

³⁴ See e.g. <http://www.kent.ac.uk/economics/documents/research/ceas/2009/Contributed%20papers/093.pdf>

	the LP. It is one of the most prominent land management measure to prevent erosion and nutrient load to waters. It is also important in the context of flooding.	the LP. Green cover can also be seen as an important adaptation measures in the case of increasing wind speeds, where wind erosion might increase, but also in the case of flooding.
Art 30 crop diversification (crop diversification: 3 crops and maximum of 70% for the main crop)	The rules to be established to implement this article have to account for environmental issues. Currently it is not précised what crops are covered, if rotation is required and if permanent cover is foreseen.	
Art 31 permanent grassland (grass land may need to be maintained on the basis of 2014)	There is a risk that farmers would plough up grassland before 2014. This would be especially destructive if it involved semi-natural permanent grassland. There is no differentiation between semi-natural grasslands that have not been used intensively and those that have been used intensively (but not ploughed and reseeded in the last five years). There is strong difference in terms of the climate benefits between the two (sequestration value) as well as biodiversity.	
Art 32 Ecological focus areas (7% of ecological focus area, such as land left fallow, terraces, landscape features, buffer strips and afforested areas as referred to in article 25(2)(b)(ii))	<p>No final definition of what can be covered by ecological focus areas as the proposal only lists option (“such as”). It can not be ensured that these areas are attached in the most vulnerable areas in terms of environmental protection such as the riparian areas, which have a key ecological role and are crucial in water protection. It also remains unclear which part of “buffer strips will be part of GEAC and which part can be accounted under Art 32. Or can this seen a “hidden” compensation mechanism for the GAEC in buffer strips?</p> <p>Further no precision on the calculation method and it remains unsure what environmental standards beyond Cross Compliance have to be met. Depending on the requirements, this could have a very positive effect but it could also fail to provide benefits over time (for example, if the ecological area can shift over the farm from one year to another). There is no link between these areas and requirements under agri-environment schemes or other environmental measures – establishing links could be beneficial in terms of improving the adaptation / mitigation effects. It is also not indicated if the list of ecological focus area includes wetlands and flood plains that contribute to water and flood protection and mitigating water stress.</p>	
Art 34-35: Payment for areas with natural constraints	No additional environmental conditions seem to be attached to these payments. Further it remains unclear which areas are considered. From a water perspective erosion sensitive / water vulnerable areas or flood plains are most relevant. In	

	the context to climate change this could also be seen as payments which are already water scarce and might lead to maladaptation.	
Art 36 (6) General rules	The Commission is empowered to set the conditions under which a legal person is allowed to receive payments. These conditions could be related to a basic advisory service including water and climate issues	
Art 38 voluntary coupled support	Coupled support to many different products without direct Commission control on the reasons for the re-coupling. This might increase the pressure on water in different areas, as it was the case before 2003.	Coupled support to many different products without clear Commission control on the reasons for the re-coupling. This might limit the possibilities for adaptation. Unsustainable production patterns from a climate change perspective might remain longer.
Article 42-44 – crop specific payment for cotton in BG, GR, ES, PT	Cotton less than 0.0025 % of the EU’s UAA (utilised agricultural area) – main areas of growth can be found in Spain and Greece. Requires a lot of irrigation. It has to be assessed to which extent cotton can be potentially grown in the EU under a changing climate. It can be assumed that in many of these regions water scarcity and droughts will increase. This measure hampers sustainable adaptation.	
Art 55 –Exercise of the delegation.	This article allows the COM to define further rules or to specify some of the legal requirements set out in the regulation further. This opportunity could be used to increase the level of environmental protection and to reduce the risk of mal-adaptation and reducing pressures on water.	

1.9.3 Proposal for a regulation of the European Parliament and of the council on the financing, management and monitoring of the common agricultural policy

Table 4-5 Special remark

Article of the regulation	Water	Climate
Art 6f other expenditure, including technical assistance	Allows for studies on the common agricultural policy and evaluation of measures financed by the EAGF and the EAFRD, including improvement of evaluation methods and exchange of information on practices. This could be used to assess the effectiveness of several measures for water management and adaptation to climate change. Based on this evaluation best practice could be shared	
Art 12-15 Farm advice system (FAS) and Annex I	Requires minimum advice on the WFD and other EU water legislation, but allows also to go beyond these legal	Art 12c requires including climate change adaptation into the FAS. Such schemes and the detailed

	requirements (Art 12c)	content needs to be developed
Art 60-67 control system and penalties. The system set up by the Member States in accordance with Article 60(2) shall include, except where otherwise provided, systematic administrative checking of all aid applications and shall be supplemented by on-the-spot checks.	Currently no minimum amount of such checks is foreseen. There is only a reference to a random part and a risk-based part in order to obtain a representative error rate. This may deserve further details in particular in the terms of amount of checks and what is defined as a risk (e.g. areas including water bodies which are of risk of not meeting good status. These rules can be set by the Com according to Art 64	No direct link to adaptation, but several measures required to be checked are also relevant for adaptation.
Art 91- 95 defining the rules for cross compliance, in particular art 93 and Annex II	<p>The WFD has been added to the list of regulations under cross compliance: <i>“Directive 2000/60/EC of 23 October 2000 establishing a framework for Community action in the field of water policy will be considered as being part of Annex II once this Directive is implemented by all Member States and the obligations directly applicable to farmers have been identified. In order to take account of those elements the Commission shall be empowered to adopt delegated acts in accordance with Article 111 for the purpose of amending the Annex II within 12 months starting at the moment the last Member State has notified the implementation of the Directive to the Commission.”</i></p> <p>However the detailed rules of application are unclear. All Ms have already implemented the Directive but the definition of <i>“and the obligations directly applicable to farmers have</i></p>	Mainly indirectly relevant (see water)

	<p><i>been identified</i>" is vague.</p> <p>The new pesticide Directive (2009/128/EC) has also been added.</p> <p>The SMR on Directive 80/68/EEC (old Groundwater Directive) has been modified. The reference to Art 4 and 5 of the Directive has been removed and replaced by a reference the Annex. The new GWD has not been considered.</p> <p>The SMR on Directive 86/278/ EEC on the protection of the environment, and in particular of the soil, when sewage sludge is used in agriculture has been removed</p> <p>The GAEC on "Buffer strips" in the proposal have the same weaknesses than the current one established: no limitations to use pesticides near water courses and no requirements for the width of the buffer or the type of planting required. This weakens the GAEC in terms of effectiveness to reduce pollution or as a water retention area.</p> <p>According to Annex II a new GAEC has been set up which focuses on the protection of wetlands and carbon rich soils (ban of first ploughing)</p>	
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	<p>As regards from the years 2014 and 2015 the rule from Cross Compliance shall also compromise the maintainance of permanent grassland. The Member States which were Member of the Union at 1 January 2004 shall ensure that land which was under permanent grassland at the date provided for the area aid applications for 2003 is maintained under permanent grassland within defined limits. The Member States which became Member of the Union in 2004 shall ensure that land which was under permanent grassland on 1 May 2004 is maintained under permanent grassland within defined limits. Bulgaria and Romania shall ensure that land which was under permanent grassland on 1 January 2007 is maintained under permanent grassland within defined limits.</p> <p>The preceding subparagraph shall not apply to land under permanent grassland to be afforested, if such afforestation is compatible with the environment and with the exclusion of plantations of Christmas trees and fast growing species cultivated in the short term.</p> <p>The Commission shall be empowered to adopt delegated acts containing the rules on maintenance of permanent grassland, in particular to ensure that measures are taken to maintain the land under permanent grassland at the level of farmers, including individual obligations to be respected such as obligation to reconvert areas into permanent grassland where it is established that the ratio of land under permanent grassland is decreasing.</p> <p>It is unclear if this rule will lead to an increase of grassland in some areas where it has decreased, but it will limit further reduction from 2014 onwards with positive impacts on climate change (mitigation and adaptation) and water management (less soil erosion, flood mitigation)</p>
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1.9.4 Proposal for a regulation of the European Parliament and of the council on support for rural development by the European Agricultural Fund for Rural Development (EAFRD)

General Remark

The disappearance of the axes (the current RDR has four main axis and each MS has to spent a minimum under each axis) in Rural Development can be noted. This can be interpreted that all the objectives for RD spending now constitute a menu from which Member States may freely compose their spending in this area. If so, the absence of any binding objectives in this respect might lead to the fact that no sufficient priority will be given

to environmental objectives or climate adaptation issues. This might further weaken the possibilities of the second pillar which seems already to lose effectiveness because of a reduced budget.

Table 4-6 Specific remarks

Article of the regulation	Water	Climate
Art 5 Union priorities for rural development	Art 5 (4) and (5) clearly refer to water management as a priority	Adaptation is not mention as one of the six priorities but several other priorities (such as facilitating diversification (Art 5 (6)) can be used for adaptation) . The article expcitley requires that ‘all priorities shall contribute to the cross-cutting objectives of innovation, environment and climate change mitigation and adaptation’
Article 8: Thematic sub-programmes		Additional support to mountain and young farmers could be used to facilitate adaptation in at-risk areas
Art 9 content of rural development programmes. It requires an analysis of the situation in terms of strengths, weaknesses, opportunities and threats (SWOT). Based on this the measures under the RD program have to be selected.	The SWOT assessments require to consider the union priorities for rural development and therefore water management.	<p>The SWOT assessments must consider adaptation to climate change. Art 9c refers to adaptation to climate change in (iv) and (vi):</p> <p><i>(iv) a pertinent approach towards innovation, the environment, including the specific needs of Natura 2000 areas, and climate change mitigation and adaptation is integrated into the programme;</i></p> <p><i>(vi) measures have been taken to ensure the availability of sufficient advisory capacity on the regulatory requirements and all aspects linked to sustainable management in agriculture and forestry, as well as climate action;</i></p> <p>Additionally, <i>point (vi): initiatives are planned for raising awareness and</i></p>

		<p><i>animating innovative actions and establishing operational groups of the European Innovation Partnership for agricultural productivity and sustainability.</i></p> <p><i>This could facilitate collaboration around adaptation actions.</i></p>
<p>Art 14-41 specifying the measures under the RD programme</p>	<p>Most relevant measures for water protection (including flood management) are:</p> <p>Art 15: Knowledge transfer and information actions;</p> <p>Art 16: Advisory services, farm management and farm relief services;</p> <p>Art 18: Investments in physical assets;</p> <p>Art 19: Restoring agricultural production potential damaged by natural disasters and catastrophic events and introduction of appropriate prevention actions;</p> <p>Art 21: Basic services and village renewal in rural areas in particular 21 (1) (a) the drawing up and updating of plans for the development of municipalities in rural areas and their basic services and of protection and management plans relating to NATURA 2000 sites and other areas of high nature value; and (g) investments targeting the relocation of activities and conversion of buildings or other facilities located close to rural settlements, with a view to improving the quality of life or increasing the environmental performance of the settlement.</p> <p>Art 23: Afforestation and creation of woodland;</p>	<p>Most relevant measures for adaptation to climate change are:</p> <p>Art 15: Knowledge transfer and information actions;</p> <p>Art 16: Advisory services, farm management and farm relief services – mitigation and adaptation actions and requirements are explicitly stated as a compulsory element;</p> <p>Art 18: Investments in physical assets;</p> <p>Art 19: Restoring agricultural production potential damaged by natural disasters and catastrophic events and introduction of appropriate prevention actions;</p> <p>Art 20: Farm and business development in particular Art 20 (1)(a)(ii) non agricultural activities in rural areas and (b) investments in non agricultural activities which allow to develop alternatives to farming as part of climate change adaptation;</p> <p>Art 21: Basic services and village renewal in rural areas which can assist farmers in business diversification</p> <p>Art 22: Investments in forest area development and improvement of the viability of forests in particular Art 22</p>

	<p>Art 24: Establishment of agro-forestry systems;</p> <p>Art 29: Agri-environment-climate measures;</p> <p>Art 30: Organic farming;</p> <p>Art 31: Natura 2000 and Water framework directive payments. As this article seems to overlap with the requirements of Cross Compliance a further clarification of the detailed implementation rules is needed. In practice it remains unclear which WFD measures will go beyond the statutory management requirements and the good agricultural and environmental conditions (Art 31 (4)(b). The statutory management requirements and the good agricultural and environmental conditions are already requiring mandatory actions by MS to be applied to farmers in Cross Compliance.</p> <p>Further it seems that while getting payments for NATURA 2000 are not linked to “major changes in type of land use, and/or major restrictions in farming practice resulting in a significant loss of income” (Art 31 (4)(d) payments for the WFD are required to do so. From a practical farmers perspective the restrictions imposed by both Directives are similar.</p> <p>Art 32 and 33: Payments to areas facing natural or other specific constraints. There is a need to further specify other specific constraints.</p> <p>Art 36 (2) (a) pilot projects and (f) joint action undertaken with a view to mitigating or adapting to</p>	<p>81) (c) prevention and restoration of damage to forests from forest fires and natural disasters, including pest and disease outbreaks, catastrophic events and climate related threats;</p> <p>Art 23: Afforestation and creation of woodland;</p> <p>Art 24: Establishment of agro-forestry systems;</p> <p>Art 25: Prevention and restoration of damage to forests from forest fires and natural disasters and catastrophic events;</p> <p>Art 26: Investments improving the resilience and environmental value of forest ecosystems;</p> <p>Art 29: Agri-environment-climate measures – there is no requirement for minimum level of funding for agri-environment measures</p> <p>Art 30: Organic farming – setting out organic farming gives additional visibility to this measure which has been proven to increase production resilience in times of drought, for example.</p> <p>Art 31: Natura 2000 and Water framework directive payments (see water);</p> <p>Art 32 and 33: Payments to areas facing natural or other specific constraints. There is a need to further specify other specific constraints (e.g. regular droughts?).</p> <p>Art 35: Forest-environmental and climate services and forest conservation</p> <p>Art 36 Cooperation in particular Art 36 (2) (a) pilot projects and (f) joint action undertaken with a view to mitigating or adapting to</p>
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	<p>climate change; (g) collective approaches to environmental projects and on-going environmental practices</p> <p>Art 46: Investments: In the case of irrigation, only investments that lead to a reduction of previous water use by at least 25% shall be considered as eligible expenditure. By way of derogation, in the Member States that adhered to the Union from 2004 onwards investments in new irrigation installations can be considered eligible expenditure in cases where an environmental analysis provides evidence that the investment concerned is sustainable and has no negative environmental impact. However it is not specified if these savings have to be returned to the environment or can be used by other sectors or at other places.</p>	<p>climate change; (g) collective approaches to environmental projects and ongoing environmental practices</p> <p>Art 38: Crop, animal, and plant insurance;</p> <p>Art 39: Mutual funds for animal and plant diseases and environmental incidents</p> <p>Art 40: Income stabilisation tool</p> <p>Art 46: Investments: In the case of irrigation, only investments that lead to a reduction of previous water use by at least 25% shall be considered as eligible expenditure. By way of derogation, in the Member States that adhered to the Union from 2004 onwards investments in new irrigation installations can be considered eligible expenditure in cases where an environmental analysis provides evidence that the investment concerned is sustainable and has no negative environmental impact. However it is unclear if these savings have to be returned to the environment or can be used by other sectors or at other places.</p>
<p>PLEASE NOTE THAT ONLY THE DETAILED SPECIFICATION OF THE MEASURES AT MS LEVEL AND THE SPECIFIC ALLOCATION OF FUNDS BETWEEN MEASURES WILL SHOW THE LEVEL OF AMBITION TO PROTECT WATER AND TO ADAPAT TO CLIMATE CHANGE. There is a requirement that 25% of rural development funding needs to be allocated to ‘issues related to land management and the fight against climate change’. Since the RDP budget will remain nominally the same and there is the possibility of reverse modulation for some countries, the second pillar with targeted funding may not appear to have sufficient funding to address the pressing biodiversity and other environmental, including climate, concerns. Moreover, it is not clear if the 25% allocation would also include measures such as ‘risk management’</p>		

	(article 37) and ‘crop, animal and plant insurance’ (article 38) which are relevant in the context of climate change – if so, then the budget dedicated specifically to land management would be even less.
Art 42 – 45 Leader	Allows to set up local action groups which could address water management and adaptation
Art 53 and Art 61 – 63. The EIP for agricultural productivity and sustainability shall: (a) promote a resource efficient, productive, low emission, climate friendly and resilient agricultural sector, working in harmony with the essential natural resources on which farming depends; (c) improve processes to preserve the environment, adapt to climate change and mitigate it; (d) build bridges between cutting-edge research knowledge and technology and farmers, businesses and advisory services.	Allows for innovative projects in the context of water management and adaptation to climate change! Among other things this measure could, for example, be used to support ecosystem-based approaches to climate adaptation.

1.9.5 Impact assessment related to the legal proposals

The related impact assessment to all proposals tabled is very weak in relation to assessing environmental impacts. The main focus is on economic impacts. However several of the main environmental concerns highlighted above are not addressed in the IA (e.g. Impact of the payments for Ecological focus areas or the impacts of the cotton payments)

Recommendations for selected EU funding schemes

1.10 Cohesion fund

In terms of the financial volume, the Cohesion Fund is of the important funding schemes of the EU, representing a share of 20 % of the EU resources for cohesion policy in the present

period of funding 2007 - 2013.³⁵ As of the Commission Proposal for the MFF 2014-2020, resources for the Cohesion Fund will slightly drop to 68.7 bn €. The fund is dedicated to strengthen the social and economic cohesion of the Community through the balanced financing of projects, technically and financially independent project stages and groups of projects forming a coherent whole. Targeting the fields of environment and trans-European transport infrastructure networks, it is key for climate proofing existing and future EU policies.

The following section is dedicated to give some **specific policy recommendations** on how to climate proof the EU Cohesion Fund. It draws on the screening of key policy areas carried out in task 2 and is equally organized around the policy areas of energy, transport, and urban areas.

- **Energy:** As far as they are aimed beneficial effects for the environment, measures in the field of energy policy are eligible for financial resources from the Cohesion Fund. Potential lies especially with the supply and the transmission of energy: As for the former, the Cohesion Fund should be used to support large-scale energy adaptation projects. As for the latter, focus should be on the enhancement of renewable energies as sources of energy supply. Especially in CEEs, renewable energies still have a great potential for development. In general, it is recommended to mainstream urgent needs for further research funding on climate-proofing the energy supply chain. The Cohesion Fund can play a role for both the demonstration and for applied projects.
- **Transport and Infrastructure:** Cohesion Policy investments in transport between 2007 and 2013 will be concentrated in the Convergence regions. It is split as follows³⁶: TEN-T projects across all transport modes will receive €38 billion (11% of the total of cohesion policy investments). About half of that will be allocated to road infrastructure and the remainder to rail. Overall, almost €41 billion (12% of the total) will be available for road infrastructure, including TEN-T and national, regional and local roads. For rail infrastructure, a total of €23.6 billion (6.8%) will be spent, including TEN-T projects. Other allocations include urban transport (€8.1 bn □ 2.3%), ports and inland waterways (€4.1 bn □ 1.2%), multimodal transport and intelligent transport systems (€3.3 bn □ 1%), and airports (€1.9 bn □ 0.5%). In the field of infrastructure and transport, a number of EU documents exists that forward adaptation measures. In the following, relevant parts are presented along with the particular policy recommendation related to it.

❖ **Community strategic Guidelines on cohesion (2006/702/EC)**

1.1.1, p16: "They should also enhance the creation of an EU-wide interoperable network. Compliance and applications of the interoperability and the fitting of ERTMS (European Rail Traffic Management System) on board and on track should be part of all projects financed where appropriate."

³⁵ http://www.bundesfinanzministerium.de/nr_1310/DE/Wirtschaft_und_Verwaltung/Europa/was-macht-europa-mit-unserem-geld/EU_Strukturpolitik/2204.html?_nnn=true.

³⁶ http://ec.europa.eu/regional_policy/themes/transport/index_en.htm.

Suggestion: With reference to the ERTMS, it is recommended to incorporate adaptation measures into the system to ensure that climate change impacts are addressed European wide in the train control and command systems.

❖ **Council Regulation (EC) N° 1083/2006 laying down general provisions on the European Regional Development Fund, the European Social Fund and the Cohesion Fund and repealing Regulation (EC) No 1260/1999³⁷**

Art. 40: "The Member State or the managing authority shall provide the Commission with the following information on major projects: (e) a cost-benefit analysis, including a risk assessment and the foreseeable impact on the sector concerned and on the socio-economic situation of the Member State and/or the region..."

Suggestion: There should be added a reference to risk assessment. It could additionally request a systematic mapping of different types of climate threats, vulnerabilities and consequences for new projects. Insofar, this suggestion contributes to capacity building in all transport modes.

- **Urban Areas:** Similar as with the field of infrastructure and transport, a variety of documents exist which can be used as a gateway to climate proofing.

a) Communication "Cohesion policy and cities: the urban contribution to growth and jobs in the regions" (COM (2006) 385 final)

p27: LIFE funds and the urban environment - The programme supports pilot projects in cities that develop new technologies, policy approaches, methods and instruments for urban environmental management, in line with the Thematic Strategy on the urban environment. For example, in 2005 LIFE supported Elefsina 2020, a project to regenerate this environmentally degraded port and city in Greece. LIFE+ has a total budget of €2 billion for the 2007-2013 period.

Cohesion policy funding for urban areas - Between 2007 and 2013, around €30 billion will be spent on urban projects within region policy programmes. In addition to the policy's financing for infrastructure and people-based actions, the European Territorial Cooperation objective (formerly "INTERREG") can be used by cities to develop joint cross-border or transnational projects.

The Commission also provides special support for cities to work together through the URBACT programme, which is a European exchange and learning programme promoting sustainable urban development. In the current programming period URBACT offered financial support to 289 cities participating in 44 different projects. The programme enables cities to jointly develop solutions to major urban challenges, reaffirming the key role they play in facing increasingly complex societal changes.

³⁷ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:210:0025:0078:EN:PDF>.

Suggestion: Adaptation needs should be formulated specifically into the future cohesion policy, which will be stronger focusing on the urban dimension

Only measures like green and grey infrastructures that improve the resilience of urban areas against impacts of a changing climate shall be funded.

The proponent of a building plan or any development needs to verify that the project is climate proof in order to receive support by the Cohesion Fund (COM 2006), like suggested in the orientation paper on future Cohesion Policy³⁸, This can be conducted e.g. by a brief climate assessment as a part of the building approval.

Cohesion policy investments should be climate proofed. Competitiveness measures will need to take into account constraints and opportunities of a low carbon economy.

The Cohesion Fund shall offer financial support for the implementation of Heat Health Warning Systems or health information systems.

1.11 Ten-E + TEN-T

Climate change questions were simply not at the forefront of public debate when the TEN-T and TEN-E policy was established in the mid-1990s. Climate change is expected to lead to higher temperatures which are expected to have a major impact on the infrastructure, and an increased incidence of extreme weather events and rising sea-levels. Existing transport and energy infrastructure, evolved over many decades with a long life-span, may not be sufficiently resilient to the harmful effects of climate change. The precise degree of such impacts as they affect individual sections of infrastructure is not always yet clear, so their vulnerability to such changes needs to be assessed and taken into account appropriately in the further development of the TEN-T and TEN-E. Further, new infrastructures need to be designed in such a way as to 'climate proof' them and build in sufficient resilience from the outset. Already the green paper on climate change in 2009 called for a policy review of the TEN-T and TEN-E policy. Based on the findings within Task 1 and Task 2.2 and 2.3 the following recommendations can be made:

- **Council Regulation (EC) No 680/2007 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL laying down general rules for the granting of Community financial aid in the field of trans-European networks:**

Art. 5 (2) Selection of projects³⁹

Suggestion: Add as further criteria: - Adaptation measures foreseen to respond to changing climatic conditions

- **Decision No 1364/2006/EC**

Suggestion: Set up an annex to Decision No 1364/2006/EC which shall provide standards for overhead as well as for underground/undersea transmission cables reflecting the higher

³⁸ http://ec.europa.eu/regional_policy/newsroom/pdf/pawel_samecki_orientation_paper.pdf.

³⁹ http://tentea.ec.europa.eu/download/legal_framework/8_regulation_6802007.pdf.

demand posed by higher temperatures and demand by consumers particularly during heat waves

- **Regulation (EC) No 67/2010 of the European Parliament and of the Council of 30 November 2009 laying down general rules for the granting of Community financial aid in the field of trans-European networks**

Art. 6.4: “Project selection criteria”

“The decision to grant Community aid should also take account of:

- (a) the maturity of the project;
- (b) the stimulative effect of community intervention on public and private finance;
- (c) the soundness of the financial package;
- (d) direct or indirect socio-economic effects, in particular on employment;
- (e) the environmental consequences.”

Suggestion: Add: “(f) the risks of damages to the project by climate change impacts.”

1.12 Agriculture

As set out earlier the current RD programmes already provide several adaptation measures related to agriculture. Pillar 2 funds measures that can address specific adaptation concerns in different regions through targeted measures and therefore funding levels should be maintained or strengthened. Moreover, additional technical support to farmers should be provided. Therefore the following measures should be included / strengthened in the next financial period of the RD programme:

- **Council Regulation (EC) No 1698/2005 of 20 September 2005 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD)**

Art 4 “Objectives”

Suggestion: Add as further objective: 1. (d) improving the adaptive capacity to climate change

Art 11 “Content”

Suggestion: amend paragraph: 3 (a): an evaluation of the economic, social and environmental situation and the potential for development “*under a changing climate*”

The measures listed under Title IV can remain the same but should allow for the following measures:

Art. 24 “Use of advisory services” and Art. 25 “Setting up management, relief and advisory services”

Suggestion: Advisory services should also include a part on adaptation to climate change in areas where a high vulnerability to climate change can be expected. This could include advice on adaptation measures, but also on diversifying farm businesses under climate change.

Art. 26 “Modernisation of agricultural holding” and “Art. 30” Infrastructure related to the development and adaptation of agriculture and forestry

Suggestion: Funding for the modernisation of irrigation should be a) coupled to gains in water saved and b) ensuring these gains are returned to the environment and not used to extend the irrigated area/water volumes used by change of crops.

Funding for cooling stables should be added to the list of infrastructure that could be funded

1.13 Suggested general rules for infrastructure funding

With regard to infrastructure funding the EU should consider the interaction of the following components:

- Individual infrastructure elements: plan, design, build and retrofit of individual infrastructure elements, such as a single road, bridge, airport runway or building. For these individual elements two cases can be distinguished in relation to EU funded projects:

a. Projects which have to be approved under the EIA Directive (85/337/EEC)⁴⁰

For considering climate change in EIA procedures a guidance document is currently under preparation by consultants to DG Environment, which will also address key issues for climate change adaptation. The ongoing revision of the EIA-Directive shall also take up the issue of climate change.

Suggestion: Integrate provisions for taking climate change into account in the ongoing process of the review of the EIA Directive. Provide explicit guidance for climate change considerations to be included in the following steps according to the information required by Annex IV of the EIA Directive:

3. A description of the aspects of the environment likely to be significantly affected by the proposed project, including, in particular, population, fauna, flora, soil, water, air, climatic factors, material assets, including the architectural and archaeological heritage, landscape and the inter-relationship between the above factors.

The description of relevant aspects will have to identify variations in and/or changes to climatic factors (e.g. precipitation, temperature, water levels, humidity, snow cover) to which the proposed project is likely sensitive. Based on available information it shall be estimated if and how regional climate change may alter these parameters and how this could interact with the project. Altering climatic conditions will likely need to be discussed on a cumulative basis as changes can be expected to multiple parameters that interact with several environmental factors.

4. A description (1) of the likely significant effects of the proposed project on the environment resulting from:

⁴⁰ <http://ec.europa.eu/environment/eia/eia-legalcontext.htm>.

- *the existence of the project,*
- *the use of natural resources,*
- *the emission of pollutants, the creation of nuisances and the elimination of waste, and the description by the developer of the forecasting methods used to assess the effects on the environment.*

Estimation whether the project related effects on the environment would pose an additional risk on the environment's (both natural and human) adaptive capacity to cope with anticipated climate change induced variations (changing precipitation patterns affecting surface waters, groundwater levels, snow cover etc.).

5. A description of the measures envisaged to prevent, reduce and where possible offset any significant adverse effects on the environment.

Measures shall be geared towards enhancing adaptive capacity both for the project itself (if sensitive to changing climatic parameters; e.g. through adjusting the project design) and the surrounding natural and human environment. A key element when considering how changing environmental conditions may be managed is the extent to which the project and/or the environment are flexible or adaptable to future circumstances.

b. Projects which are not subject to EIA

Following the above mentioned requirements for EIA projects, funding for other infrastructure elements should at least take into account the project related effects on the adaptive capacity of its environment and, if necessary, apply appropriate measures. A short list of criteria to be met for funding decisions could be envisaged.

- Whole infrastructure networks (e.g. TEN-E, TEN-T networks): entire system or network around particular infrastructure sectors of which individual elements are a component. Funding should consider this more holistic approach. There might be cases where a single bridge is climate proofed but the infrastructure network itself is in a highly vulnerable area. Applying SEA (Strategic Environmental Assessment) can serve as a tool in preparing sound information for decision making also for funding.
- Cascading elements and networks (e.g. harbor-rail connections): the influence of individual infrastructure components' vulnerability to climate change impacts on other infrastructure elements and systems (indicates the inter-connectedness of the different components of climate change). This aspect is essential when funding projects which are connected to multiple infrastructures.

It is recommended that these even general elements are further outlined in specific guidance documents for practitioners as soon as the funding rules for the next financial perspective are agreed.

1.14 RTD funds

Effective solutions for sector-wise adaptation require additional RTD allocation. In the following we have depicted concrete suggestion on how to fill in research and knowledge mainly addressing the forthcoming EU-FP8.

In general only a few studies use both social economic scenario's and climate scenario's to project possible futures. This means that in several projects climate impacts are projected for current society neglecting the huge changes in societies over 50 years. A few studies quantify impacts at European scale. Most studies focus on smaller areas. For climate impact studies both changes in the average weather and changes in extreme events are important. Again few studies address both. Furthermore, especially in non-economic sectors it is difficult to quantify economic impacts. Overall, the results of different projects are difficult to combine as they are based on different assumptions, scenarios and methods.

1.14.1 General remarks

With respect to all sectors focused on (cf. fn. 3)), research is needed to find out more about the costing of measures. The available literature sources often allow only an uncertainty range which encompasses several orders of magnitude. There are also uncertainties regarding the modeling of adaptation as well as the definition and transfer of unit costs. Therefore in many cases the (gross) costs of adaptation measures are not well understood.

Also there is a need for a better understanding of the impacts of the suggested measures, especially of autonomous adaptation. It is still difficult to separate pure climate change adaptation measures from adjustments to e.g. an increased volume of traffic. Further research is needed to find out more about these special adaptation measures.

Finally, there exists huge uncertainty about the climate impacts on some sectors like soils or fisheries due to multiple impacts likely to increase in intensity with time. Substantial impacts of climate change are already apparent. Nevertheless, in many cases the scientific proofing and differentiation between human use impacts and climate change impacts are still needed.

1.14.2 Energy (focus on electricity production):

Until recently, the energy sector has been mostly regarded as addressee of mitigation options and measures. Yet, projects and literature on necessary adaptation measures in the energy sector – mostly to safeguard energy supply under future climate conditions and to meet new demand patterns partly connected to climate change – are still rare. At global scale, first overview publications on climate impacts and existing adaptation measures and options have recently been published (cf. Worldbank study by Ebinger & Vergara 2011 and Williamson et al. 2009).

Still, the adaptation of energy production/supply and its distribution is still very premature, but needs much more intention – explicitly with the 20/20/20 goals and the shifting mix in energy production. So also the cost information of potential adaptation measures is lacking.

Within the components of the energy system the following headers can be depicted to track the gaps in research and according research funding. On the supply side, **a coherent and supplier-oriented approach to assess impacts on** (cf. Tebaldi et al. 2006) **and vulnerabilities of the European energy system** – especially to extreme events, extreme weather periods and potential abrupt climate change is needed (e.g. in relation to a potential weakening of the gulf stream). Furthermore, a detailed **assessment of the vulnerabilities in renewable energy sources** seems inevitable. A focus should be placed on **hydro-energy**, since its share in energy supply is already large in many countries. **Hardening infrastructures** towards more and intensified extreme events is necessary for both – supply (power stations) and distribution (grid infrastructures).

Smart grids are already well under research. Nevertheless, all activities should be scaled up to European level and supported mainly through research for **electricity storage systems, new materials for transmission and the management of energy demand, system operations after disruptions and an increasing share of renewable energy**

For all research and in particular for early warning purposes, a sufficient information base on **energy meteorology** in terms of weather modeling (radiation, cloudiness, etc.) is urgently needed. For scenarios about climate impacts on the energy sector, energy meteorology should be **forward projected** by applying climate scenarios (e.g. ENSEMBLES, HadCM, ECHAM).

1.14.3 Infrastructure and transport

Climate change impacts and in particular adaptation of transport infrastructure is a new field in research and only recently a number of projects have started. Expected outcomes from the projects such as EWENT, WEATHER, ECCONET, QUANTIFY (all FP6 or FP7) might provide some suggestion and advice for further action on the EU level. Nevertheless, the issue of climate change on transport is in general an under-researched topic and more information on threats to be expected on a regional level and adaptation options are required. In particular, climate change adaptation and **aviation** needs to be assessed in detail, given that no European research project could be identified in this field.

In addition, more research is needed on appropriate adaptation measures. More specifically, research is essential on **technical question** such as how to enhance the resilience of materials used taking into account an expected increase of temperature and shifts in precipitation. This knowledge is particularly necessary to be able to suggest concrete amendments in standards and regulation. Also cost information of such adaptation measures are lacking and should be subject to research.

Regarding the output of the research projects, its practical application and support to policy makers should be guaranteed. The results should provide guidance on e.g. vulnerability assessment, climate-proofing of new and existing transport infrastructure, etc. In general, **transdisciplinary and applied research approaches** are recommended.

1.14.4 Urban Areas

The research needs have been assessed based on efforts in this project and the currently running effort of the EEA, “European cities facing climate change - Reducing vulnerability by multi-level governance”. The EEA report describes generic adaptation options and provides guidance for smart urban adaptation and will be published in early 2012.

More research efforts need to be placed on the effects of **urban green and blue infrastructure**, assessing best practice examples and their effects, based on e.g. GRaBS⁴¹ project results. The focus shall be placed on the impacts of climate change on diverse European cities with different climatic conditions (based on the SUDPLAN⁴² project results) and possible adaptation options related to effects of temperature increase and changes in precipitation patterns. Close cooperation with cities is seen as a prerequisite to ensure uptake of the project outcomes.

Additional research is needed for adapting **urban buildings** (including design, building type, water storage and communication infrastructure) and **built environment**. The focus shall be placed on indicators and guidance on how to climate-proof (e.g. via a brief climate assessment as a part of the building approval) urban development's and buildings, from an interdisciplinary perspective, involving inter alia urban planners, urban transport planners, building and water authorities and construction companies. An uptake of the INTERREG IV B project Future Cities⁴³ results should be envisaged.

Basic research is needed to better assess **heating effects** in urban areas, especially transferring and developing novel adaptation options from Southern European (e.g. compiled by the CATMED⁴⁴ project) to Northern European (e.g. Future Cities project) countries and vice versa. This shall be linked to the outcomes of the Noah's Ark⁴⁵ project (Global Climate Change Impact on Built Heritage and Cultural Landscapes).

1.14.5 Agriculture

Most research related to agriculture and climate change focuses on crops, while effects on livestock may be substantial as well. More research into the effects of climate change on livestock and how livestock production can be made more resilient is therefore needed. In scenario studies not much attention is paid to extreme weather events. Extreme events can play an important role in production damages. Scenario studies often ignore socio-economic conditions and adaptive capacity at farm and sectoral level. Since effects of climate change differ between regions, there is need for increased attention on regional studies of impacts of climate change. There is also a considerable need to better estimate the costs and cost-effectiveness of various adaptation measures including the best design of policy measures to

⁴¹ <http://www.grabs-eu.org/>.

⁴² <http://www.smhi.se/sudplan>.

⁴³ <http://www.future-cities.eu/>.

⁴⁴ <http://catmed.eu/>.

⁴⁵ <http://noahsark.isac.cnr.it/>.

maximize synergies between adaptation and other environmental objectives, including mitigation and provision of ecosystem services. Social dimensions of Moreover, the linkages between adaptation at farm level and adaptation more broadly within food the system need to be understood.

1.14.6 Close knowledge gaps for other sectors

For the other sections not mentioned above some characteristics of the knowledge base and some knowledge gaps have become visible. This knowledge base could be increased by research. Overall, the following knowledge gaps relating to the different other sectors have been identified:

- Land-use and soil: More with respect to monitoring, refinement of methodologies for measuring both soil carbon stocks and fluxes is needed. A major gap is the lack of understanding and quantification of the impacts of freeze-thaw and drought-rewet events on soil carbon (Schils et al. 2008). Quantitative data about the costs of climate change related to soils and land use is hardly available. Also data about the social impacts related to soils and land use are lacking.
- Forestry: The socio-economic adaptation capacity related to the forest sector has rarely been analysed in the EU. Literature on (northward) spread of pests and diseases is virtually absent. It is unknown if increased growth due to higher CO₂ levels will outweigh drought effects in forest productivity. Further, quantitative data to describe the environmental, ecological and social effects of climate change on the forestry sector are very site-specific due to ecological and socio cultural diversity. Therefore it is difficult to give a generalized overview of these effects at EU-level. Regional studies focussing at the impacts, adaptive capacity and adaptation are necessary.
- Biodiversity: The information of the economic damage of lost ecosystems is limited. There are economic key numbers of the economic value of ecosystems, but there are not yet calculations of how these values will change under climatic changes. There is little information on the impact of climate change on the establishment of invasive species. There is little information on the impact of weather extremes on the fluctuation and recovery of populations and effective adaptation measures.
- Fisheries and Aquaculture: There are no scenario studies for fisheries and aquaculture. Interactions in the food web are hard to predict; for example it is unknown how plankton blooms will coincide with growth of larvae and small fish
- Freshwater resources: The main knowledge gaps in the area of water resource vulnerability are economic consequences of future flooding, water scarcity and drought; inter-sectoral linkages increasing vulnerability; and future changes in water quality and their effect on water quantity and ecology. They need to be filled as pre-requisite for effective adaptation planning,
- Coastal areas: About the climate impact on coastal infrastructure and offshore some effects are known, but knowledge is lacking how these will change in the future. There are no sea level projections for the Black Sea.

- Infrastructure and transport: Impacts are only available for a few EU countries with a bias towards Scandinavian countries; nothing is available on southern and Eastern Europe. There is very little information on socio-economic aspects. Concrete and preferably quantitative assessments of consequences of climate change and associated costs are hardly available.
- Industry and services: Specific numbers related to the impacts of climate change on industry, services and tourism are hardly available.
- Health: The vulnerability of cities has not yet been investigated properly. Cities might be more vulnerable because of the high population densities, the urban heat island effect and the air quality. On the other hand the health care system might be better in cities. At the moment there is not enough insight in the impact of climate change on European health, due to the complex interactions with other factors. As a result the effectiveness of adaptation measures has not yet been investigated properly. The economic impact of health risks is not included in most of the adaptation literature.

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