Statistiska centralbyrån Statistics Sweden

# Climate change adaptation expenditure

## – A proposal for a methodology to compile, define and classify national and EU economic information as statistics

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## Preface

Statistics Sweden (SCB), in cooperation with the Institute for European Environmental Policy (IEEP), have produced a report Identification and Elaboration of Methodology to be used in the classification and costing of projects and programmes for adaptation to climate change as part of a project commissioned by DG Clima to develop a new methodology on the statistics needed to help define the costs and expenditure of climate change adaptation. This work is guided in part by the principles outlined in the impact assessment of the White Paper on adaptation to climate change (European Commission 2009/387). This project was developed by the European Commission, DG Environment and subsequently moved to DG Clima.

The current report in your hand is an extract of the full project report *Identification and Elaboration of Methodology to be used in the classification and costing of projects and programmes for adaptation to climate change*. The full report focuses on two relevant aspects: quantifying the cost of adaptation, and expenditure on adaptation. Regarding cost estimates of adaptation projects and measures, the report provides a proposal for the assessment of cost estimates based on what economic data is currently being compiled, what different approaches are available to do this, and what the differences are between the approaches. Excluded from this extract report are following chapters: Chapter 2- definitions and guidelines related to cost estimates, chapter 3 – the bulk of literature review related to typology, chapters 5-7 as they relate to cost estimates and chapter 8 – the literature review of existing reports on expenditure on adaptation to climate change. What remains are the discussions and proposals on how new statistics on expenditure related to adaptation to climate change could be developed in the future. This encompasses definitions, guiding thoughts on delimitations, typology issues on how to link this new information to existing statistics in the economic or social sphere and how a set of tables might be developed that would cover the important areas of adaptation and collected EU-wide.

The authors of the full report were: From Statistics Sweden Nancy Steinbach (project manager) and Viveka Palm, from IEEP Jane Desbarats and Keti Medarova. The extract report was produced by Nancy Steinbach and Viveka Palm.

Statistics Sweden, May 2011

Inger Eklund

Viveka Palm

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# Summary

This project focussed on government measures for adapting to climate change, with the goal of proposing a system to standardise data flows for the measurement and ex-post monitoring of economic data as well as proposing a methodology used to calculate adaptation costs. This paper is a summary of the findings related to the statistical field of proposing a system to standardise the data flows related to expenditure for adapting to climate change.

Regarding expenditure on adaptation, the report proposes a new methodology to quantify adaptation expenditure through the compilation of new statistics. It describes how the EU is currently accounting for past spending on adaptation in its budget, whether EU Member States hold any statistics on how much they have spent on adaptation, and if so, what types of measures are included as part of these statistics.

The project has only looked at planned measures (i.e. government activities). Aspects related to autonomous measures (i.e. private activities) are not covered as part of this report.

From a statistical point of view the standards aim at consistently categorising items so that adaptation measures do not blend into one another. But more than that, they provide a framework to which additional information can be added to enhance a specific study or project, if applied correctly.

The project emphasises the need for testing the developed proposals. Even though the work builds fully on existing approaches and methodologies, the standardisation process always takes time. By testing the proposals, adjustments and improvements can be made in order to provide the maximum possible benefits in the form of reliable results and credible platforms.

The project proposes:

- Applying a single definition of climate adaptation for statistical purposes and for cost estimates; the definition proposed to be followed is that developed by the IPCC.
- A typology following the statistical classification COFOG (Classification of the Functions of Government) for data reporting, to enable compilers to rely on existing and established processes of allocating measures, projects or other activities.
- That national statistical offices should support continuation of the work undertaken by the project by establishing a new statistical area on expenditure for adaptation, through either DG Clima or DG Eurostat.
- That DG Clima could lobby for the area of expenditure on adaptation to become part of the future statistical legislation on Environmental Accounts.

# 1. Project specification

## 1.1 Introduction

The Intergovernmental Panel on Climate Change (IPCC) states that there is no doubt that the climate system is warming. Empirical observations reveal increases in global average air and ocean temperatures, widespread melting of snow and ice, and a rising global mean sea level. Analysts agree that climate change will have significant economic and social impacts with some regions and sectors likely to bear greater adverse affects. Certain sectors of society (e.g. the elderly, disabled people, low-income households) are also expected to suffer more (EC 2009).

The European Commission is stepping up its efforts to combat the effects of climate change. In a recent White Paper a framework is proposed in order to help reduce the EU's vulnerability to the impact of climate change (EC 2009a). This framework highlighted (section 8.2.) the notion that information on the costs of adaptation measures remains fragmented and limited, although estimates and methodological guidelines are provided in various reports (e.g. EEA, 2007; OECD, 2008; Parry et al., 2009, EC 2007, IES 2006). Some preliminary results have already been produced as part of the FP6 ADAM project[1] (EC 2009b).

## 1.2 Project setting

In recent years, the European Commission and EU Member States have increased support for climate adaptation through numerous EU and national funded projects and programmes. However, the way in which costs are presented for projects funded by the EU structural funds or the European Bank for Reconstruction and Development for example, does not allow for a proper assessment of the funds allocated to adaptation. The lack of a comprehensive approach could mean that many adaptation projects are overlooked in the calculation of funding support. Agreeing on a methodology for calculating the costs of adaptation is likely to become even more pertinent given the UNFCCC reporting requirements[2]. Given the uncertainty surrounding the future of the Kyoto Protocol, certain assumptions may need to be made around the applicability of the UNFCCC requirements.

[1] ADaptation And Mitigation (ADAM) strategies for climate change. More information available http://www.adamproject.eu/

[2] The EU is a party to the United Nations Framework Convention on Climate Change (UNFCCC). The UNFCCC contains very clear substantive obligations for all parties on adaptation to the adverse impacts of climate change, most of which are found in Article 4. (see http://unfccc.int/essential_background/convention/background/..) Under Article 4(1), all developed and developing countries agree to formulate and implement national programmes containing measures to facilitate adequate adaptation to climate change.

Many of the priority areas for internal EU funding (i.e. EU Structural and Cohesion Funds - the EU's main instruments for supporting regional development) either directly or indirectly benefit the environment and climate. However there is currently no accepted methodology for calculating the percentage allocated to adaptation as part of these projects and programmes. The forthcoming EU budget review could further assess the options available for future adaptation funding as part of the post 2013 multi-annual financial framework.

This action requires quite a lot of prior information and knowledge on the relevance of the climate change challenge for the appropriate EU funded measures. Thus preparatory actions for this option should include a dialogue with Member States' management authorities (or potentially through a dedicated Adaptation Committee), climate experts, exchange of information (maybe through a platform consolidating the information available), training, improved use of existing programme management control and monitoring tools.

## 1.3 Objectives and scope

The objectives of this study are in accordance with the tender specifications:

a) To conduct an extensive review of available information on expenditure and costs[3] of adaptation (from projects, programmes and appropriations) on adaptation measures within the EU (and when appropriate neighbouring countries) and a review of existing methodologies for identifying these expenditures and costs.

b) On the basis of the research/fact-finding, to assess and compare such methodologies identifying the methodological and data challenges associated with calculating the expenditure on adaptation.

c) To propose a set of criteria for classifying different projects, programmes or budget lines and calculating the expenditure on and propose a system to estimate the "adaptation share" for projects not exclusively intended for adaptation as well as producing a list of frequently occurring cases and borderline cases.

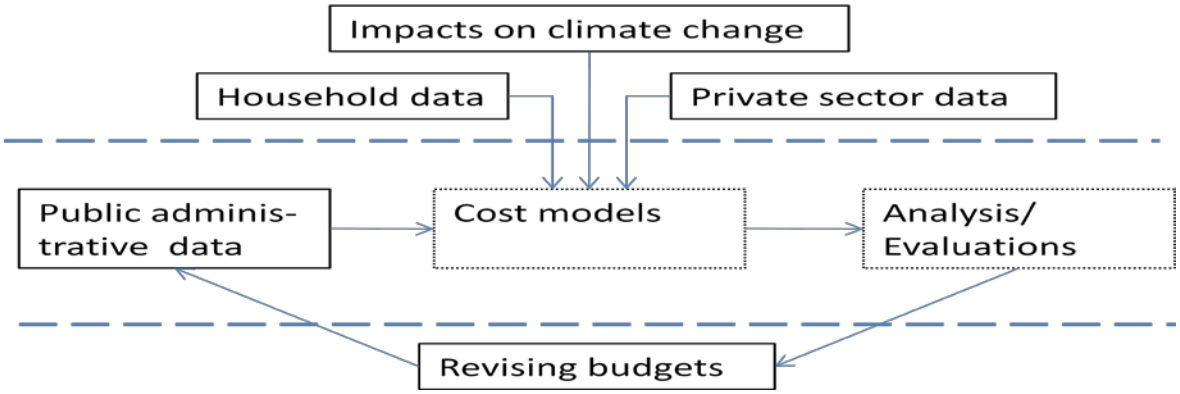
d) To elaborate on the linkage between the cost curves that concern the future cost and the expenditure that measures the current cost.

While the scope of adaptation options considered as part of this project focuses on planned adaptation measures fully or partially financed by public authorities, some small-scale private autonomous adaptation measures (e.g. farm-level adaptation practices, air conditioning, etc.) may be used to illustrate some of the complexities associated with cost calculations. Figure 1 outlines the overall scope of the project, while also illustrating the interaction between private autonomous measures and some of the input data required to estimate costs for both types of measures. While the analysis of cost methodologies will contribute to the formulation of a new methodology that could be applied to EU budgetary

[3]. The term "expenditure" in the context of this report is used to describe funding that has already been allocated to adaptation measures or adaptation related programmes for various levels of government; while adaptation cost refers to unforeseen expenditure commonly determined on the basis of forecasting models.

line items, this contract does not undertake any work of the budgets themselves.

**Figure 1**
**Scope of the project**




The Adaptation White Paper indicates that there is a lack of statistical standards that can be applied to adaptation measures. Despite the fact that the issue has recently been highlighted on the political agenda, its standardisation has not yet come to fruition. It is the opinion of the contractors undertaking the analysis outlined herein, that closer cooperation between the scientific and the statistical community is required if robust results are to be produced that are comparable across countries.

The application of methodologies to calculate adaptation cost in the context of budgetary decision-making, and the allocation of funds, could vary considerably depending on the corresponding user needs. As outlined in Chapter 6 the combined weight of both previous spending estimates and forecasted cost estimates as part of an adaptation cost calculation will vary depending on the availability of data, the type of adaptation measure under consideration, the year in question, and the need to determine new spending requirements that are "additional" to business as usual. The need to determine new and additional spending will apply equally to planned measures and autonomous measures, and to decision-makers who are in the process of allocating funds specifically to climate change adaptation.

Evaluating existing spending requires involvement of an institution with access to budgetary data, or administrative registers. This project outlines a similar data collection system using the statistical concept known as Environmental Accounts. This is an area that resembles the National Accounts (from which e.g. Gross Domestic Product is estimated), but also includes environmental and environmental economic parameters. At the moment there is a proposal to the European Parliament and Council to include parts of the Environmental Accounts under a Commission Regulation. These relate to air emissions, environmental taxes and material flows (EC 2010). It would be possible to continue and extend the Regulation in time with additional environmental economic statistics.

Standardising the collection of data related to adaptation will be crucial in forecasting adaptation cost. For any country to be able to accurately quantify cost, more information on impacts will need to be collected and other potential default values of the cost function will need to be

determined. Determining a cost function therefore serves two purposes: it helps to determine what information is needed to calculate cost, and it helps policy makers determine what constitutes additionality in terms of allocating funds for climate change adaptation objectives.

## 1.4 Consultations

This project has benefited from the expertise of people already involved in the area of adaptation. The following groups and experts have been consulted during this project.

**Eurostat Reflection Group**
At the Joint Eurostat/EFTA Working Group on Environmental Accounts held in Luxembourg March 23-24 2010 a new "Reflection Group" was established for the assistance of this project. Seven countries volunteered to participate in the group: Slovenia Vida Butina (Statistical Office of the Republic of Slovenia), The Netherlands Sjoerd Schenau and Isabel van Geloof (Centraal Bureau voor de Statistiek, CBS), Austria Alexandra Wegscheider-Pichler (Statistik Austria), the UK Donna Livesey (Office for National Statistics (ONS) and Rocky Harris Department for Environment Food and Rural Affairs (Defra), France Stephane Levasseur (Ministère de l'Écologie, de l'Énergie, du Développement durable et de la Mer (MEEDDM)), Finland Eila Salomaa (Statistics Finland) and Italy, Cesare Constantino, Istat.

The Reflection Group has provided:

- An overview on countries' experiences/activities/definitions in the area of climate change adaptation (including monetary information).
- Comments on the proposed definitions for expenditure on adaptation to climate change.
- Comments on a categorisation/classification of expenditure on adaptation to climate change as well as how to assign the expenditures to these categories.
- Comments on a standard statistical approach to be developed, including an outline of a new set of standard tables. These could be developed in such a way that DG ESTAT would take over the data collection and in such a way ensure the data quality of the gathered information. This would mean the involvement of national statistical offices or similar.

**Benefits from reference group meetings**
The project has benefited from three discussions in Brussels with officials and experts:

DG Clima: Vaidotas Kuodys, Adeline Dontenville

DG Environment: Jaques Delsalle, Alessandra Vakrou, Birgit Snoeren, Astrid Ladefoged, Tom van Ierland, Karin Zaunberger

DG Agri: Myriam Driessen, Joao Silva

DG Aidco: Alessandra Sgobbi

DG MARE: Ana Ruiz

DG Eurostat: Julie Hass, Marina-Anda Georgescu and Velina Pendolovska

European Environment Agency: Stephan Isoard

European Investment Bank: Giulia Macagno

Additional consultation (meetings, telephone conversations and email contact) has been carried out with other key stakeholders as outlined below in Table 1.

During the last week of the project additional helpful comments and ideas were provided by: Salvador Barrios Joint Research Center, Dr. Jochen Harnisch Competence Center Environment & Climate KfW Development Bank, Gianluca Azzoni DG AIDCO, Alistair Hunt University of Bath and Reinhard Mechler IIASA - International Institute for Applied Systems Analysis. Many thanks go to them for their time and most useful comments for improving the report.

**Table 1**
**Consultation Overview**

| Relevant Organisation | Contact | Information Obtained | Relevance to Report |
|---|---|---|---|
| European Bank for Reconstruction and Development (in reference to a meeting of the European Financial Institutions Working Group) | Craig Davies | Discussion of methods to assess adaptation cost in the private sector. | Discussions determined that most banks still have not agreed on a specific approach to determining to cost of adaptation. |
| Department for Food and Rural Affairs, UK | Michael Mullan | Emphasised importance of UKCIPS information, and that of the UK Treasury. | Information used extensively in the development of a replicable cost assessment methodology. |
| University of Reading | Dr. Paul Williams | Discussion of forecasting; challenge of predicting climate events and to what extent it is possible to determine a ”business as usual scenario” for climate variability. | Findings discussed in Chapter 7; emphasised the need for policy makers to agree on a specific baseline year. |
| Free University of Berlin | Dr. Martin Wattenbach | Ibid | Ibid |
| University College of London | Dr. Anne Johnson | To discuss possibility that the formulation of health plans could be relevant to adaptation planning given the unpredictability of both types of events. | Discussions indicated that in the case of the swine flu in the United Kingdom, government officials did not utilise a formalised decision-making process to respond to unanticipated threats to public health. |
| DG Aid | Alexandra Sgobbi | Methodology related to OECD DAC and Rio Markers | Chapter 5: Overall literature review; comparison of cost assessment approaches |
| DG Env | Guenter Raad | Discussion indicated challenge to harmonising a single approach to cost assessment | Chapter 7: development of a cost assessment methodology |
| DG Budget | Philippe Cattoir | Information on EU and public finance | Chapter 8: Summary of conclusions |
| Centre for Research on the Epidemiology of Disasters | Régina Below | Methodologies on damage costs and typologies | Chapter 3 and Chapter 4 |

## 1.5 Statistics and modelling

A brief description of the basic principles of statistical data gathering is crucial in order to understand some of the limitations of data collection in relation to this project. In relation to adaptation cost estimates, which are based heavily on modelling approaches, it may be possible to gather data in relation to a number of data inputs, but it will be more difficult to gather data in relation to specific cost models given the variability in applied approaches. As explained below, statistical data gathering needs to adhere to the standard European Statistics Code of Practice.[4] Modelling is based on a specific objective and the ambition of the entity or person undertaking the analysis. Many good practices in the statistical field, such as the issue of "Coherence and Comparability", justify the completion of a number of tasks as part of this project; the need to establish definitions for key inputs for example, is crucial in order to generate comparable cost estimates.

There are many types of data that feed into the calculation of costs for various projects (not just those related to adaptation). Some of this data is produced in a regular fashion, typically by national statistical offices. If the intended data collection efforts are part of the government's statistical data collection plan, they are often called official statistics and their compilation requires compliance with the accepted European quality criteria.[5] The compilation of statistics primarily involves reporting on what has already happened, showing national trends from year to year. Statistical data today is generally gathered in relation to the general population, or features of the general population, and other key elements of the economy. This information is generally collected either through questionnaire-based surveys where specific questions are posed to different respondents or from administrative registers where the compiler makes do with the information already available.

When compiling data in relation to the environment, the types of inputs that are measured vary widely. Some inputs relate to the quantification of the usage of resources that have more direct implications for the economy, (e.g. energy use, water use and waste management) and are collected using questionnaire based survey methods similar to those used for other data parameters connected to the general economy. Other data related to the state of the environment is collected through research projects undertaken 'in the field' (e.g. taking samples of aquatic species from lakes, or using satellite images to calculate the average growth of forests). In short, most of the data gathered is based on empirical observations.

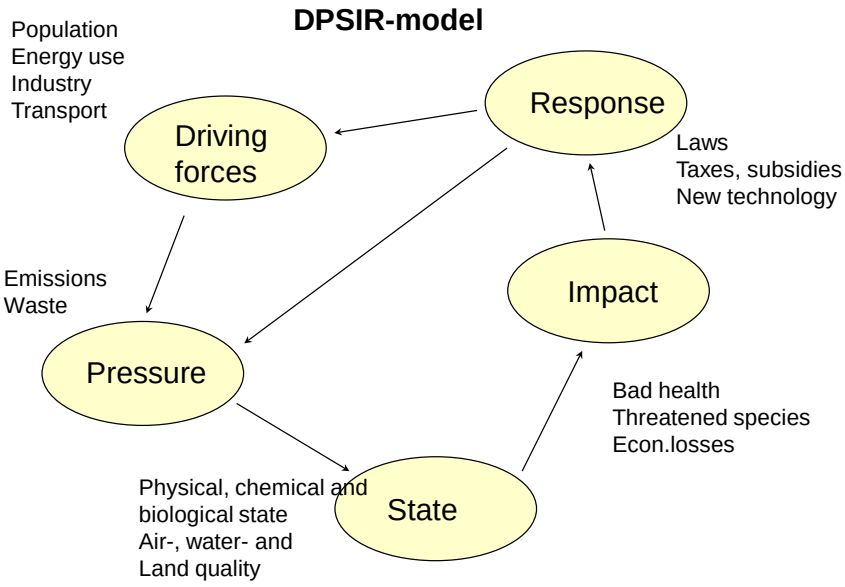
Gathering statistics involves collecting data that is not based on subjective analysis, and that is obtained on the basis of a standardised data collection approach involving a more straightforward quantification of different input variables. For this reason, the usage of data collected through economic analysis such as cost benefit analysis can be a delicate issue in a statistical context. In some studies, the value of intangible assets (or services) that are not bought and sold on markets is required. In these

[4] . See p. 7, http://epp.eurostat.ec.europa.eu/portal/page/portal/quality/documents/code_practice_EN.pdf

[5]. Ibid

instances, it will not be possible to gather statistics in relation to the more objective and often qualitative appraisal of non-market cost variables obtained through willingness to pay analysis for example. The results of such analytical methods may depend too much on contextual project circumstances to be regarded as valid for statistical purposes.

**Figure 2**
**The DPSIR-model**




The differences in the availability and the stability of statistical data can be illustrated by the DPSIR-framework.[6] The statistical system is designed to measure the impacts of drivers such as the rate of population growth, the rate of economic growth, changes in land use, and the nature of changes to the transport sector (such as the number of vehicles purchased, the number of trips taken, etc…). From an environmental standpoint, statistics can measure the pressure of driving forces such as the rate of emissions growth, and trends in the accumulation of waste. The state of the environment is often represented through the use of a wide range of local measurements which, along with pressure related indicators, are often scaled up in different ways to produce meaningful figures on a national scale.

When it comes to environmental impacts, there is often a considerable amount of modelling in the data presented, especially if a causal link is to be established between data outputs and the phenomena leading to those outputs. For example, it is possible to measure the number of hospital visits associated with the impact of heat waves, but in order to understand the reasons behind the total number of hospital visits, assumptions have to be made and hypotheses tested to determine whether heat waves are truly the

[6]. The DPSIR-model (Drivers, Pressures, State, Impacts and Responses) was designed by the OECD and further developed by the EEA in order to describe the different components needed to develop environmental indicators.

cause of the stated hospital visits. Therefore, while statistics can illustrate the correlations between different variables, the causal links are not always easy to establish.

If one considers the national responses to driving forces, outlined in the DPSIR model, statistics on economic responses (or ways through which to address the economic impacts of some of the driving forces) are available from budgets. This could include the total amount of revenue collected through tax collection efforts; a tax that may have been implemented to fund the pressures or impacts of driving forces. Statistics could also illustrate how the public responds to stringent laws on technology development in terms of measuring behaviour change in relation to purchasing particular goods. (Laws encouraging the uptake of more environmentally friendly products could be measured in this way.)

Returning to the project at hand, we are looking at ways in which to make the use of statistics as user friendly as possible in order to measure different elements of adaptation to climate change. It is important to note however, that some of the data for the cost estimates needs to be assessed for local cases. The cost estimates could use statistics to assess the price impacts of goods vulnerable to climate change, but the key concern of such a calculation involves estimating the impacts associated with future events. In some cases, assessing costs, also involves measuring the value of applicable benefits; a variable that is not easily quantifiable. Estimating both the future costs of adaptation and the potential benefits presents a challenge in terms of accounting for adaptation cost in a deterministic fashion.

As a brief example, the Swedish assessment of future adaptation costs (SOU 2007:60) can be used. The study calculated cost estimates of future costs for adaptation in Sweden. According to this assessment, the bottom-up cost estimates are so locally determined, and so uncertain, that is was difficult to use cost curves in selecting the most appropriate measure (a technique often applied to mitigation). When looking at the benefits of the adaptation measures, these are not one-dimensional. Some measures are intended to save lives, others to minimise economic damage to property or to production. Referring to this example, while it may be possible to measure cost using comparable units, the qualitative assessment required to measure benefits makes a comparative assessment of outputs extremely challenging.

In summary, while it is possible to standardise the use of various data inputs in calculating the cost of adaptation. It would not be advisable to gather cost estimates as part of a standardised statistical data-gathering exercise given the variability in cost calculation outputs, and the impact of different contextual factors. It would be possible however, to use a register such as the Adaptation Clearinghouse to track estimates for analytical and comparative purposes.

## 1.6 Project objectives and overall methodology

### 1.6.1 Basic analytical approach

The overall research and analysis completed as part of this project followed a series of building blocks in order to determine past funding amounts and what additional funding may be required to address future adaptation in the EU. The analysis sought answers to a number of different questions:

1) What types of methodologies exist today that measure either past spending or anticipated costs for adaptation?
2) What definitions have been used in relation to data inputs used as part of these methodologies?
3) What typologies have been applied for the classification of measures assessed as part of spending and cost methodologies?
4) How can cost methodologies be improved to better reflect the complexities of estimating adaptation cost?
5) How can the existing accounting systems be improved to better reflect expenditure on adaptation to climate change?

The completion of various tasks as part of this project addressed these questions, although to a large degree, authors of this report faced a significant challenge in terms of the availability of relevant information. In short, while there is a vast amount of literature available describing international approaches to adaptation cost and expenditure, there is a lack of information available to substantiate national accounting for adaptation spending and the application of methodologies to quantify cost. The recommendations made as part of this report, and the establishment of improved accounting methods, will help address the fundamental information gap associated with this project.

# 2. The use of definitions

## Summary of findings

As a second result of the completed literature review, this project has been able to identify several key terms that are needed for a thorough analysis that can be easily compared. However, as revealed by the literature review, some terms can have multiple meanings. As such, there are a number of ideas and concepts that have not been developed as part of a standardized approach to either cost calculations or to the gathering of adaptation cost or adaptation expenditure related statistics. (For the purposes of this report, guidance related to the use of the terminology in similar analytical exercises is provided to help illustrate the meaning of the terms.)

The term "Adaptation" for example, has itself generated a number of associated definitions. The IPCC, the OECD and the World Bank definitions encompass more technical adaptation measures while the EEA and the OECD definitions encompass measures that facilitate behaviour change. In relation to statistical data gathering exercise, the authors of this report maintain that it is important to apply a definition that encompasses the widest possible range of attributes for a given term, and that can be used to describe a number of different situations. For this reason, it is important for a statistical data compiler to be familiar with the range of applicable definitions, to be able to consider these in producing statistical end results, and to choose that which best reflects these realities. This helps ensure that the system boundaries of a given term or account entry has been determined based on the necessary due diligence.

## 2.1 Introduction

A definition includes text that explains the meaning of a term (a word, a phrase or other sets of symbols) or a type of thing[7]. In the statistical sphere, definitions are a fundamental starting point prior to proceeding with a new data collection process. The definition guides the compiler as to what should data be gathered, it explains the scope of the area or object and enables the compiler to uncover similar data on a global scale that is applicable to the definition in question.

In Europe, the standards for statistical data gathering are determined by the European Statistical System (ESS). The ESS is a partnership between the Community statistical authority, which is the Commission (Eurostat), the national statistical institutes (NSIs) and other national authorities responsible in each Member State for the development, production and dissemination of European statistics.[8] The partnership ensures that data that is developed, produced and published in such a way that European harmonization of data is maintained. Eurostat collects and maintains a database "Eurostat's Concepts and Definitions Database" or CODED.

[7] http://www.merriam-webster.com/dictionary/definition, http://en.wikipedia.org/wiki/Definitions

[8] http://epp.eurostat.ec.europa.eu/portal/page/portal/about_eurostat/european_framework/ESS

CODED contains definitions of key terminology and concepts used within the ESS, which enables any compiler of statistics to keep up to date on several definitions and concepts, as well as providing transparent information to the user of statistics.

A number of different definitions exist that relate to the terminology for "Adaptation". In order to apply a definition that covers the measures of interest, it is important to consider the differences between definitions and to see which one may serve as the most useful basis for the development of a statistical work package, and for the development of an adaptation cost methodology. This means that the applied definition should be as transparent as possible, easy to interpret and operationalize. One could say that the purpose of a definition is to bring meaning to a specific concept. With respect to this project, selecting an appropriate definition will help to scope out the right type of measures for analysis.

Comparable statistics across countries, sectors or areas can only be created if certain rules are set and applied by the statistical compiler. This includes specifying sampling units, sampling frequencies, the time of data compilation and coverage. As the definition sets out the coverage it is important to consider following principles (Reingruber and Gregory 1994):

- It communicates what the area represents[9];
- It states the general meaning followed by some relevant details, exceptions, and a couple of representative examples;
- This definition stands alone; it is not dependent on other definitions to convey its meaning. Circular definitions would violate this rule;
- It is logically organized and articulated in full sentences.

The language used to define adaptation should cover as many measures as possible without limiting the selection of such to what is "on the agenda" at the current time. A definition could be applied in this way to help determine the appropriate typology for adaptation measures. While it would have been possible to base a selection of measures on an existing definition of adaptation, the project team has considered three types of measures based on those outlined in the White Paper Impact Assessment (green, grey and soft) in analyzing the appropriate cost assessment approaches. Referring to this typology of measures has enabled us to assess the costs of measures that could be implemented by different levels of government across a range of economic sectors. This ensures that any proposals to enhance budgetary allocations consider a sample that is representative of a wide breadth of policy alternatives.

A number of already existing potential definitions are outlined below.

[9] It avoids describing how, where, or when the definition is used, or who uses it. This means that the same definition can be used in different situations regardless of who is applying it.

## 2.2 List of definitions

### 2.2.1 Definition – adaptation measures

The IPCC is the leading body for the assessment of climate change today. It has a data provision mandate and provides scientific reports on climate change.[10] A definition for adaptation was provided in its Third Assessment report which was again reiterated in the Fourth Assessment report as outlined in point 1 of Box 1 below. The definition focuses on two elements of adaptation indicating how specific measures may respond to climate change. The first focus of the measurement should be activities that respond to actual or expected climate stimuli. The second focus of the measurement should be activities that respond to the secondary effects of actual climate change stimuli. The World Bank definition, included as part of point 5 of Box 1 has not deviated from this practise despite their own modification of it.

The OECD definition (according to ADF France) in point 4 clearly states that it is the intention behind the implementation of an adaptation measure that separates it from business as usual practices associated with day to day resource management. This means that adaptation can be an activity that has been put in place before the actual event takes places or reduces damage that has already occurred. The definition does not specify whether the implemented measure needs to be effective but only that it should respond to stimuli based on a stated intention to address climate change adaptation as an area of concern.

The EEA and the OECD definitions, as outlined in points 2 and 3 in Box 1 focus their respective definitions of adaptation practises or projects that are able to moderate harm or realise opportunities. The effectiveness of the measures in terms of their ability to meet these two requirements are crucial elements of the compilation of statistics.

[10]. Intergovernmental Panel for Climate Change

**Box 1**
**Adaptation definitions by four international organisations**

1) **IPCC TAR/AR4 (2001/2007):** adaptation is defined as "adjustment in natural or human systems in response to **actual or expected climate stimuli or their effects**, which moderates harm or exploits beneficial opportunities associated with climate change."
2) **EEA (2005):** adaptation is defined as "policies, practices and projects with the **effect** of moderating damages **and/or realising opportunities** associated with climate change, including climate variability and extremes and sea level rise."
3) **OECD (2009):** Adaptation **reduces the impacts** of climate stresses on human and natural systems. It consists of a multitude of behavioural, structural and technological adjustments.
4) **OECD (according to ADF France):** An activity should be classified as adaptation-related if it **intends to reduce the vulnerability** of human or natural systems to the impacts of climate change and climate-related risks by maintaining or increasing adaptive capacity and resilience.
5) **World Bank:** Adjustment in natural or human systems in **response to actual or expected climatic stimuli or their effects**. Adaptation can be carried out in response to (ex post) or in anticipation of (ex ante) changes in climatic conditions. It entails a process by which measures and behaviors to prevent, moderate, cope with and take advantage of the consequences of climate events are planned, enhanced, developed and implemented (adapted from UNDP 2005, UKCIP 2003 and IPCC 2001).

The UNFCCC[11] is enhancing the work of the IPCC by requiring countries to report on adaptation measures in national reports known as National Communications with respect to their national implementation of the Convention to the Conference of the Parties (COP) although the required detail has never been specified. The White Paper of the European Commission in their assessment followed the IPCC definition for their use and if the IPCC definition was to be applied in future work it would have a worldwide impact.

### 2.2.2 Definitions and guiding thoughts on the adaptation component of a measure

Prior to defining the adaptation component of an actual measure, it is important to have a clear understanding of the term measure itself. There are numerous types of measures that could be considered. Adaptation measures can be hard measures including those implemented as part of infrastructure projects for example, or soft measures such as broader policy measures. The standard IPCC definition (2001/2007) states that an adaptation measure represents an "adjustment in natural or human systems in response to **actual or expected climate stimuli or their effects**, which moderates harm or exploits beneficial opportunities associated with climate change".

Adaptation to climate change can be "autonomous" or "planned". As defined by the IPCC (2007), autonomous adaptation "does not constitute a conscious response to climatic stimuli, but rather is triggered by ecological changes in natural systems and by market or welfare changes in human

[11] United Nations Framework Convention on Climate Change

systems." Planned adaptation is the opposite of autonomous adaptation and "is the result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain or achieve a desired state (IPCC 2007)".

(The issue of planned adaptation could raise some questions around additionality. In a mitigation context, reductions are not typically considered additional if they are legally mandated given that they become part of the business as usual scenario. This is more discussed in the full report, in section 2.2.7.)

Unfortunately, it was not possible to identify a precise definition for this term in the literature. One could assume however, that in applying the definition of measure to the assessment of past or present funding, you would need to consider to what extent this "adjustment" (as outlined above) is additional to a business as usual scenario.[12] In other words, to what extent has climate change necessitated the adjustment of measures in order to cope with the impacts of climate change. Increasing the height of a sea wall to cope with predicted impacts represents the "additional component" of a measure. Parry et al. (2009) describe how adaptation is part of the overall response to climate change, but their definition of this response subsumes broader objectives such as mitigation (reducing the extent of climate change) and the residual impacts (damages that will happen even though mitigation or adaptation measures have been implemented). They conclude that most estimates on the costs of adaptation are underestimating the true cost given that *"the additional costs of adaptation have sometimes been calculated as "climate-mark-ups" against low levels of assumed investment"* (p. 7).

In the case of management of the built environment, this includes responding to an increased number of events and natural hazards. This includes funding for strengthening of roads, harbours and dams. These costs will be covered by any cost estimate or expenditure statistics but the specific detail relating specifically to adaptation to climate change needs to be clearly identified. The difference between business as usual investment and additional investment needs to be assessed. This problem has been tackled within the statistical community in relation to environmental protection expenditure statistics, to solve the issue of what part of an investment can be considered 'environmental' (Eurostat 1995, 2005). If for example you invest in a new fleet, which happens to perform slightly better than the old one, then only a minor part of that investment can be regarded as environmental.

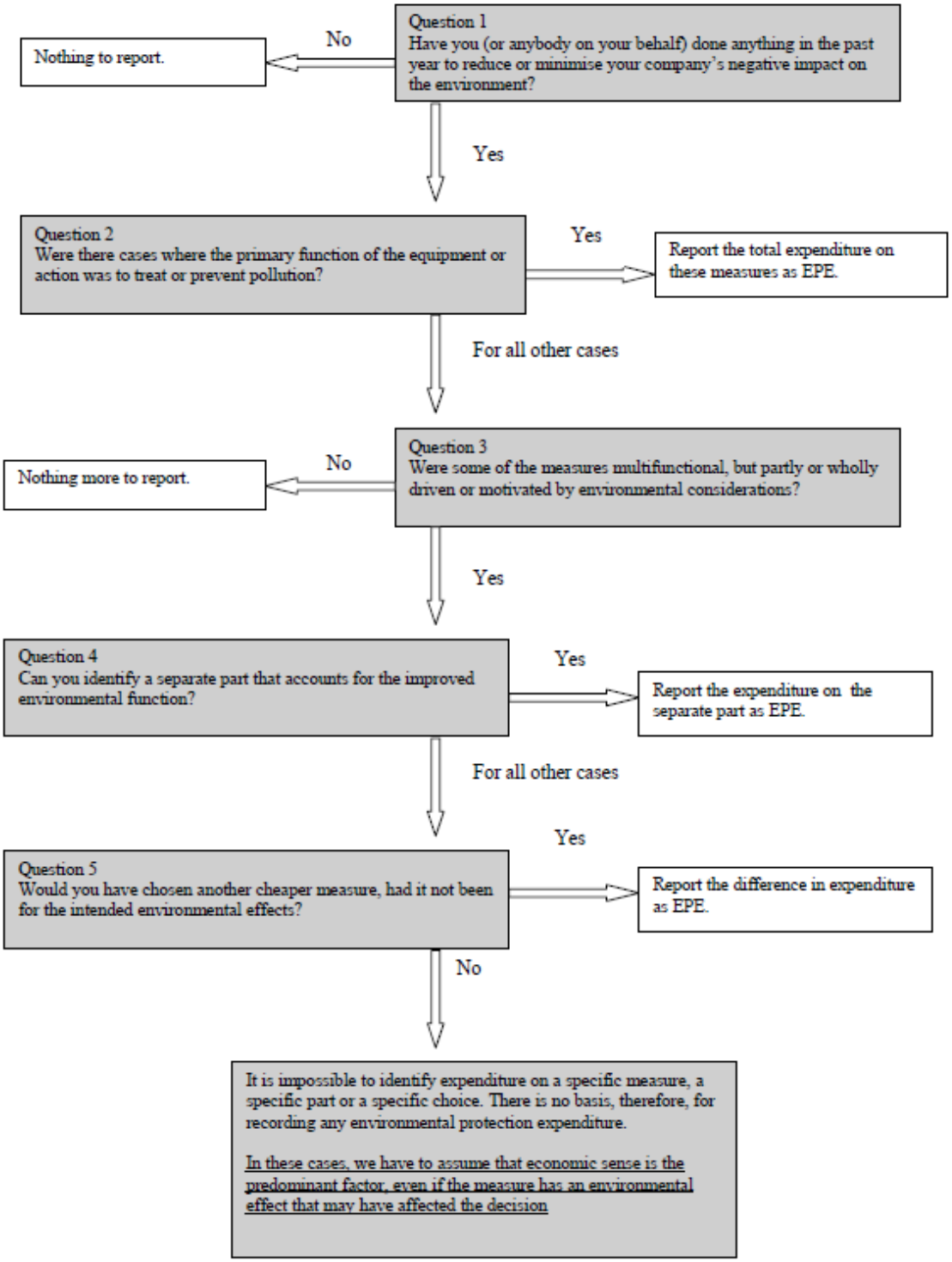
Eurostat has created a tool that could simplify the determination of additionality in an adaptation context. Tools that are used to determine how much additional funding is allocated to environmental technologies as opposed to generic technologies, could be used to assess the additionality of adaptation spending. Using a survey approach, it has been possible for Eurostat to ask enterprises how much they invested in environmental

[12]. The term "business as usual scenario" is used throughout this report to illustrate the fact that adaptation measures have not been applied. The term "baseline" is used to describe the actual measurement of a particular scenario. Greater detail on the use of this terminology is provided in Chapter 7, and as part of the relevant definitions in section 2.2.7.

technologies as a percentage of their total investments. (The same method could be used also for adaptation expenditure and will be described in chapter 4.) Additionality in an expenditure context is slightly different from that used in the assessment of adaptation cost. Determining how much additional funding has been allocated to adaptation is a straightforward exercise; it is simply a matter of stating that expenditure can be considered adaptation. This is what is referred to in this project as determining the "adaptation share" of spending. In projecting the cost of adaptation in relation to specific measures, additionality is a question of determining the incremental cost of responding to impacts based on different scenarios.

Eurostat has provided guidelines on how to proceed with such issues in that several steps needed to be thought through before reporting the added share. Ideally, expenditure related to the adaptation component of infrastructure should be publicized. Making expenditure more transparent could help determine to what extent the percentage expenditure on adaptation deviates from standard spending totals. This is discussed in the context of national accounts in the next section.

**Figure 3**
**Guideline for determining extra share in environmental investments**




Eurostat 2005, page 19.

### 2.2.3 Definition of total adaptation expenditure

The technical details related to the establishment of national accounts are described in the European System of Accounts 1995 (ESA95). EU Member States are obliged to deliver data to Eurostat in relation to their national accounts; these data are structured within tables that constitute the ESA95 Transmission Programme. Through this reporting mechanism several important macro indicators of the economy are produced, such as the Gross Domestic Product (GDP) of a nation, the Gross Value Added of a specific sectors contribution to the GDP but also total expenditure of government objectives (or functions).

| **European System of Accounts (ESA 95) input variables for total expenditure** | |
|---|---|
| Gross capital formation + Acquisitions less disposals of non-financial non-produced assets (transaction OP5AK2) | + |
| Subsidies (D3) | + |
| Property income (D4) | + |
| Intermediate consumption (P2) | + |
| Other taxes on production + Current taxes on income, wealth, etc.+ Adjustment for the change in net equity of households in pension funds reserves (OEB) | + |
| **Total expenditure of functions of government** | |

As this report will demonstrate, including spending in relation to adaptation as part of such a system would help set an important precedent. Including adaptation expenditure as part of a transparent, itemized system, will make governments and other stakeholders accountable for any action they are taking to address the impacts of climate change.

## 2.3 Conclusions: the need to operationalise the definitions and guidelines

This chapter has listed and discussed a few definitions and guidelines related to the climate change adaptation field of expenditure statistics. The need to establish definitions in a statistical context is important for two reasons: firstly, it is necessary to select definitions based on language that allow the compiler to apply a considerable amount of flexibility in accounting for a wide range of variables, and secondly, particular definitions need to be agreed to by the relevant decision makers and project developers in order to help develop a consistent approach as part of both statistical data compilation. This involves determining what the appropriate definitions may be for specific data inputs and the applicable tools necessary for the estimation of future adaptation costs.

# 3. A proposed new typology

## Summary of findings

In summary, most of the information reviewed thus far shows that there is a strong consensus on what to communicate, at least for the more important areas where vulnerability is an issue, e.g. for different business actors who are reliant on natural resources, social segments and ecosystem services. The literature review for this project covers typologies for both cost estimates and national reporting obligations to the United Nations for example. Disaster prevention, agriculture, infrastructure and human health are almost always categories shown in the studies covered. The studies specify in general terms which measure goes to which category and communicate the cost implication of that particular adaptation measure. However, even a superficial overview shows that the main headings in the studies examined have trouble with clear allocation techniques and transparency, something that is very important for evaluating and concluding results.

The typologies indicate that any measure could be categorised under any of the headings making it difficult to determine how it could be categorised. The typology of existing expenditure categories becomes more complex if certain parameters are to be cross-referenced against what is produced for different economic sectors. This is particularly true for additional environmental statistics required in undertaking an integrated assessment. The cross-dimensional nature of the categorisation of adaptation measures throughout the literature does not allow for a clear indication of what the measures mean to the economy at large and cannot be linked to other environmental economic statistics. As such it also became clear that the descriptions of what each heading included were ineffective in terms of explaining that it would, for example, not be possible to summarise statistical findings across sectors (in relation to one particular measure) or add additional information from other sources. Using the existing labelling of headings from literature, it is possible to distinguish between measures that are intended for environmental protection as opposed to those related to economic production related issues. The evaluation showed that the allocation of certain measures was not clear-cut and there was a question about the arbitrariness of the allocation technique.

During the project it became clear that the different stakeholders within the European Commission would like to find their specific topic clearly visible in a new typology on adaptation. However, each sector-specific topic would need the underlying statistics to be openly available and not subject to major confidentiality issues. The proposal is therefore to compromise, focusing on parameters that should be comparable across sectors and across countries. It should also be possible to link any subject matter to the typology while also linked to other general economic or social statistics.

The proposed typologies below are a result of adjusting to the needs of the European Commission to recognise some particular domains of interest and the statistical pathway to increase the transparency of the allocation. But it is also developed so as to enable other types of statistical information

to be added in relation to future analysis of the area. It is a typology that would cover all sectors of interest equally. The reason is that future statistics need to have a link to other related socio-economic statistics to enhance the analysis and the structure of that specific sector of interest. We have not developed a separate typology for each sector because of this line of thought.

The proposed typology follows the Classification of Functions of Government (COFOG) and is a type of hierarchical classification. This means that it provides a pyramid-like structure and ranges from the broadest level to the most detailed level. The typology is also extended to add an extra dimension in the form of types of climatic events by following the classification structure of the Emergency Events Database (EM-DAT).

This project only looks at planned (governmental) measures which should typically render a simple matrix-free typology. However, as there will most likely be a wider interest in the future to also classify expenditure and cost estimates for autonomous measures, this report also proposes a typology that can be cross analysed using a typical classification of economic activities, in Europe called NACE[13] as a second step after the establishment of government-related information.

Statistically the problems of multipurpose measures and activities have been a long-standing issue. In most cases the reality of the world and the reality of statistics are different. This means that with statistics, most items needs to be allocated to one and only one box, category or such like. The reason being that most statistics should be compiled to facilitate a total to be calculated and avoid double counting. In relation to government statistics but also general environmental economic statistics, the solution has been to look at the main purpose criterion. In terms of government spending it has proven less complicated than for enterprise-related statistics, given that the public sector does not undertake certain activities to increase its own profit (as a general rule). By using the main purpose criterion and not the effect of the implemented measure, there is a question of the time scale, i.e. the effect of a measure sometimes takes longer to show and the second reason is that the effect needs to be evaluated separately.

The proposed typology should be applied to highly aggregated data on planned measures. This means that the typology does not include a specific heading related to regional issues.

It is also proposed not to create a specific table on the grey and green infrastructure measures and soft-non-structural approaches as described in the White Paper due to the difficulties this will create to link this categorisation to other relevant economic or environmental data. Instead the European Commission can allocate the different sector categories as proposed, bearing in mind that consideration has to be made to the quality of the data as each sector can contain all three aspects of grey, green and soft-non structural approaches.

[13] Statistical Classification of Economic Activities in the European Community

## 3.1 Introduction

It is important that new statistics establishes a draft outline of where and how certain measures should be classified/categorised early on. This will facilitate the communication of the area to users that are not necessarily experts in this field. It will also facilitate the data collection as clear guidelines will need to be available for the data compiler. The idea of using statistical classifications in the context of expenditure for adapting to climate change is to use existing statistical frameworks as much as possible, and to facilitate the link between the economy and the environment.

A classification is defined by a boundary of the total set of categories. The scope of the NACE classification is defined by the term "economic production boundary" as found in the *System of National Accounts (SNA-93)*. Extending the scope of a classification requires extending the conceptual boundary (Hoffman, Chamie 1999).

Building a classification is designed to create an exhaustive and structured set of mutually exclusive and well described categories. There are certain principles and established practices to follow when constructing a new classification (Hoffman, Chamie 1999):

a) The objectives and statistical priorities to be served must be clearly stated;
b) The organisation responsible for the preparation and maintenance of a classification (the custodian) should be clearly identified and responsibilities stated;
c) A time table for the work must be well publicised and allow substantive experts who are users and producers of statistics, to contribute to the process at appropriate junctures;
d) A well-defined classification structure must be prepared. Depending on descriptive and analytical needs, aggregated categories of statistical classifications may be organised in a hierarchy representing different levels of detail for measurement of the variable.
e) Descriptive definitions or exhaustive listings of the contents of the defined categories are needed. Listings will not be needed for aggregate groups when the codes are constructed to make transparent where the correspondent groups are located in the hierarchical structure.
f) Instructions are needed on effective use of classifications for data collection and analysis;
g) Guidance and training materials are a necessary part of the development process for a new or revised classification.

**What is the purpose?**
A new type of classification system is needed in order to accurately account for the purpose of payments to adaptation measures.

Statistical classifications are used for:

a) presenting statistical information;
b) the collection of information and/or organisation of information already collected;
c) aggregating and disaggregating data sets meaningfully for purposes of analysis, including the construction of indexes;

In this specific project we are considering measures that meet a public purpose. Here, there is a need to combine some existing environmental classifications with outstanding issues that are of interest to this project. Such outstanding issues are notably the health issue and the economic losses from climate change that are not labelled as environmental, but focussed more on core human interests that the average citizen cannot control. These areas are also in need of some more specified categories that outline the types of hazards that produce damage, making it easier to determine adequate response measures. According to the literature, human health issues are attributed to heat waves, flooding, storms and possibly also some climate-related sicknesses.

The full report contains a review of several studies including existing databases that encompasses adaptation measures. However, this extract report only includes the discussion surrounding the White Paper Assessment as it is the focus of the work from the European Commission.

## 3.2 Reviewing the White Paper Assessment

**The White Paper Assessment**
The White Paper sorts measures under the general headings of Grey infrastructure, Green infrastructure and Soft-non structural measures. In addition it sorts measures with respect to general policy, forestry, biodiversity, water, soil, agriculture, fisheries, energy, infrastructure, tourism, industry, health and coastal areas. More succinctly, this means, for example, that the grey infrastructure relates to the industries that build and maintain society's roads, dams, harbours and communications, the soft non-structural approaches relate to the policy instruments that the state can administer, and the green infrastructure is represented by the industries that maintain the green infrastructure, that is the agriculture and forestry sectors.

Table 2 below maps the main groups related to grey and green infrastructure measures. For the purpose of this report the categorisation of grey and green to each sector of the White paper the most common measure (i.e. the measure that is most likely to be implemented) has guided the results in Table 2. That means that the categorisation of grey and green is not without measures from one another, or from soft non-structural approaches either. A more detailed table is available in Annex 1.

**Table 2**
**EC typology**

| EC | Category | Description |
|---|---|---|
| Green | Biodiversity | Ensuring high diversity in species, compliance checks into spatial planning, strengthen nature conservation measures table 5, p.66 |
| Grey | Water | Desalinisation, addressing flood risks, water demand management, ensuring stable water cycles, technological measures to help soil infiltration, anti-erosion measures etc. Table 6p.69 |
| Grey | Soil and land use | Flooding, reducing loss of organic matter by adapting existing cultivation practises, soil improvers/fertilisers, controlling erosion, controlling salinisation, changing crops to halt loss of biodiversity. Table 7p.74 (only land use, no description for soil) |
| Green | Agriculture | Changes in land use/management, irrigation practises, crop changes , reducing/avoiding soil degradation (loss of organic matter, erosion, salinisation) by adapting existing cultivation practises (ploughing in crop residues, using green manuring) use of soil improvers and organic fertilisers. Table 8p.80 |
| Grey | Forests | Reforestation and reconstruction after large storms, reducing habitat fragmentation to increase resilience of forest, diversified species and age structure, changing land use to forest for habitat restoration. Table 9p.86 |
| Grey | Fisheries and Aquaculture | Productivity aspects, efficiency in production by more energy-effective fishing gear and methods, removing over capacity, to allow the recovery [of fish stock?] up to an adequate level of resilience. Fishing new species. Table 10p.91 |
| Grey | Energy | Supply and demand. Measures to deal with demand changes, adapting nuclear plant maintenance, investing and installing extreme peak load facilities or alternatives, policies to ensure sustainable generation and distribution, location of energy supply, energy grid management. Table 11p.95 |
| Grey | Infrastructures and Buildings | Public infrastructure (road, water ways, bridges etc), coast defences, both hard and soft, vulnerability of transport networks to climate events. Planning and building codes, materials, techniques, urban planning, land use planning, relocation activities. Table 12p.100 |
| Grey | Industry and Services | Tourism and industry: ski-resorts' adaptive measures, industry production, investments and location issues, increase efficiency in the use of raw materials, water and energy in the production process. Table 13p.103 |
| Grey | Health | Air quality controls, food safety, acclimatisation, heat related mortality, greening of urban areas, green roofs, location issues of public health. Table 14p.108 |
| Grey | Coastal areas | Includes parts of measures described above: tourism, industry, water availability, water quality, biodiversity-ecosystems, protection against flooding etc. P.109-113 |

The categorisation of the White Paper (grey, green and soft) measures is intuitively not easy to understand, i.e. they do not speak for themselves without direct explanations as to the corresponding measures. This situation might of course apply to other types of classifications as well. What is important in this case is the issue of enabling the connection of basic support statistics to the analysis. For example, if there is a cost estimate or even expenditure statistics on grey infrastructure measures the user of the results would be quite limited in terms of utilising conclusions

that could be drawn based on that data. In order to enhance that analysis by linking these measures to other related statistics/data, the user would have to first find out what type of activities had been included (e.g. new roads, irrigation techniques applied, or construction activities) and then see if those exact activities could be matched with sectoral economic statistics (e.g. value added from the construction industry or the output of the agriculture industry) to further enrich the conclusions. Statistics today are developed with different categorisation techniques.

In brief; the evaluation shows that the previous use of the categorisation of grey and green infrastructures and soft non-structural approaches has been to include the same type of measures under different main sector headings (e.g. grey infrastructure measure flood control ended up in both the Water and the Soil and land use sectors). The evaluation undertaken as part of this literature review was not able to determine if the measure was actually the same measure recorded twice or two different measures with different purposes. In general, the typology of the White Paper Impact assessment showed that this approach was repeated throughout all the data and tables presented, making it difficult to determine whether double counting was occurring.

**A list of measures – helping the categorisation**

A list of measures has been compiled from the Impact Assessment of the White Paper 2009/387. The examples of measures from the document served several purposes. Firstly it is a list of ideas that the European Commission felt were important in order to address adaptation issues and should be ideas that Europe listens to and perhaps even implements. Secondly the list of measure was a way to use the IPCC definition as a starting point when scoping the area. The Impact Assessment follows the IPCC definition in its own scoping of the area and it was interesting to find out how they had interpreted the definition. Thirdly the list of measures served as a good point of departure to test the typology approach anticipated for this project.

Each measure was extracted from the White Paper Impact Assessment and then further checked with the categorisation chosen and the definition of an adaptation measure. Through this work a total of 167 measures, checklists and other credible concepts were recorded.

It was clear that not all measures followed the IPCC definition (as the authors see it). Some measures were clearly related to mitigation issues, e.g. energy issues and energy efficiency. Some measures were too broad to really provide informative guidance, such as measures only described as "General economic measures - social inclusion and immigration". Also removed were ideas such as "Measures to improve air quality". The White Paper reasons that it improves the resilience but the authors do not see how the IPCC definition relates the improvement of air quality, unless air quality improvements are associated with specific weather events.

Table 3 shows how the measures can be categorised:

**Table 3**
**Summary of the list of measures by proposed categories in White Paper**

| Category secondary aggregates | Total |
|---|---|
| Biodiversity | 16 |
| Biodiversity/checklist | 1 |
| Biodiversity/Forest | 2 |
| Economy/Biodiversity | 4 |
| Economy/Social protection | 3 |
| Health | 13 |
| Other | 20 |
| Other/checklist | 16 |
| Social protection | 11 |
| Soil | 10 |
| Soil/Economy | 1 |
| Soil/Water | 7 |
| Water | 6 |
| Economy/construction | 5 |
| Economy/urban planning | 3 |
| Economy/government | 4 |
| Economy/agriculture | 14 |
| Economy/insurance | 1 |
| Economy/production | 7 |
| Economy/energy distribution | 3 |
| Economy/tourism | 4 |
| Economy/fisheries | 5 |
| Economy/aquaculture | 1 |
| Economy/other | 2 |
| Economy/transportation/energy distribution | 1 |
| Economy/Forest | 7 |
| Total | 167 |

The issues that the Commission will need to address are assessments of the funds allocated to adaptation, how much is given and how it could trace spending on new approaches or initiatives. Additional analysis relating adaptation measures to mitigation activities also comes within the Commission's remit.

The categorisation could take a couple of directions; this paper suggests two distinct versions following the established classifications of existing data collections.

This area of statistics is still in its infancy. It is clear that obtaining detailed information will be difficult, and that it would be preferable to focus on a higher level of data aggregation. In terms of supra-national or national involvement most measures are related to setting up strategies, implementing them and ensuring sufficient communication among stakeholders.

Initially the project anticipated that, like the three broad categories of the White paper, some similar categories should be needed in terms of

assessing some broad aspects of adaptation. The proposal was evaluated on the basis of the list of measures from the White Paper and several points were seen that did not render it useful for further development. The first issue concerns Research and Development (R&D). Expenditure for R&D could be allocated to all three categories. However, it could be that R&D activities would be very interesting to follow separately.

The second issue concerns insurance activities. The White Paper describes several insurance activities that could also be included in all three categories in relation to planned measures. It could be argued that planned measures would not include insurance activities and not be an issue here. However, it could be that government legislation or incentives to encourage the development of insurance tools would then fall under the definition.

This categorisation is very rough and there could be a potential problem of separating governance from management at all times which was seen as the third problem in the categorisation.

However, based on these findings and the experiment, the work could continue to look into other classification options.

## 3.3 How could the adaptation measures be structured?

**Who are the actors?**
Planned measures are mainly government interventions to the economy or to society. Today there exists a statistical framework measuring the activities of government and their functions. The European System of Accounts of 1995 (ESA95) clearly sets the system boundaries for a number of issues related to the economic welfare of a nation.

For the purposes of this particular study we will apply the system boundaries of ESA95 for the institutional sectors related to government. It will also rely on the existing classification of government functions (COFOG). The classification is used to allocate government outlays by certain categories of specific objectives. This classification is described below.

**How can new information be organised?**
If the COFOG were to be applied, adaptation measures are likely to be found in all categories and if the categories are kept there is an excellent opportunity to create indicators that match existing macro level statistics. Annex 2 shows the full COFOG classification including sub-categories. By following COFOG the statistics compiled on adaptation expenditure would cover all aspects of government spending ranging from housing, health, education and environmental protection. It would thus ensure that all areas are considered and it would be easy to describe where data is readily available and where it is not.

In future applications of the classification it might be of interest to follow autonomous measures. In such a case, we are able to base some of our analysis on the existing industrial classification system that defines the following economic agents: agriculture, forestry, fisheries, energy producers, water industry, construction industry and diverse industries including the service sector where tourism is covered through the NACE

classification. Households could also be added to that list in order to cover the entire economy.

Through literature it is evident that the main focus of adaptation today is on disaster prevention. The COFOG does not enable such an analysis and a new typology needs to be established. The Centre for Research on the Epidemiology of Disasters (CRED) hosts the Emergency Events Database (EM-DAT). The reason for proposing this classification is that it is established and has well-defined categories with a specific allocation technique available. By extending the typology to also cover climatic impacts one would be able to assess how much is spent on preventing/adjusting/accepting climatic events by each specific category. Today there several measures implemented for coastal protection. These are a response to e.g. storms and floods. There are also measures to deal with wild fires or severe temperature changes.

Through their work the typology related to climate events can also be established for the area of adaptation. The project has identified that most countries support adaptation activities after an impact assessment and that climatic events are somewhat easier to deal with in terms of data availability. The proposal is shown in Figure 4.

In order to compile desired statistics or cost estimates it may be necessary to create a number of different data compilation tables. These tables will vary depending on the level of interest, data availability and the relevant analytical requirements. In this paper a step-wise approach is suggested made up of three levels, see Figure 4 below.

- First level A: contains total expenditure for adaptation to climate change;
- Second level A1: contains the same information broken down into more detail using the COFOG, i.e. the totals of A1 equals A;
- Third level A1.1: sub-component of level 1 and 2 where specific analysis is made based on data availability and interest. In our case the specific interest would be to evaluate the expenditure due to extreme weather events.

It is anticipated that the headings outlined under Table A1 could in the future be divided into NACE categories using a cross-sectoral matrix or into larger groups e.g. General government, Private sector and Households.

**Figure 4**
**Proposed structure of typologies on adapting to climate change**

**Table A:** Total Adaptation Classification
S.1311 Central government
S. 1312 State government
S. 1313 Local government
S.1314 Social security funds

**Table A1:** Adaptation by functions of government
01 - General public services
02 - Defence
03 - Public order and safety
04 - Economic affairs
05 - Environmental protection
06 - Housing and community amenities
07 - Health
08 - Recreation, culture and religion
09 - Education
10 - Social protection

Of which

**Table A1.1:** The Direct Disaster Prevention Classification

DDP.1. Storms
DDP.2. Floods
DDP.3. Extreme temperature
*Of which*
*DDP.3.1 Heat Wave*
*DDP.3.2 Cold Wave (Frost)*
*DDP.3.3 Extreme Winter Conditions (Snow, icing, rain, avalanches etc.)*
DDP.4. Drought
DDP.5. Wild fires (forest, grass, scrub etc. )
DDP. Epidemic (viral-, bacterial-, parasitic infectious diseases etc)
DDP7. Other

## 3.4 Conclusions: importance of integrated assessments

The challenges of establishing a new typology are multitude. The typology needs to be communicative, not be difficult to use as a result of operational compilations and preferably, suitable for use in combination with other existing typologies. The proposal builds on the idea that all sectors should be treated equally. However, sector-specific experts might argue that one cannot treat each sector equally in the actual calculation of the estimate or statistic. One will lose some of sector-specific quality by following a general approach but the point of departure for this proposal is for the results to be used by, for example, the European Commission or analysts that look at nation-wide information. As such, the importance lies in international comparisons of results and transparency of overall methods.

The Eurostat Reflection Group was consulted on the typology and the allocation techniques. Their answers indicate a movement towards a typology that clearly separates measures directed at the environment, society and economic affairs as is now being proposed. Knowing the work of the national statistical offices the Eurostat Reflection Group could see that as the area is completely new in relation to expenditure statistics a path forward is to look for easy targets and quite highly aggregated information before moving towards more refined solutions.

The proposal given is therefore based on existing international statistical classifications that will facilitate any future needs of integrated assessments. The proposal is to use the Classification of Functions of Government (COFOG) and the classification on natural disasters from the Emergency Events Database (EM_DAT). This will enable a connection to government expenditure through the framework of the European System of Accounts (ESA95) but also a link to weather-related phenomena.

As the classifications have been established for some time, the allocation technique is well described.

Table 4 show an example of how the COFOG related statistics can be viewed today. Each category can be further disaggregated and also shown by country. In relation to adaptation, one can already see that the expenditure in 2008 would certainly not exceed 1.8 percent of GDP in EU27 in, for example, Public order and safety if we followed the COFOG typology. This would mean that the subsidies provided to the economic actors of a country would not be above 2 percent of GDP. We can also see that the share in most categories has remained stabile over time in relation to GDP revealing that any allocation of funds for adaptation would not have affected the totals.

**Table 4**
**Total general government expenditure by function, percent of GDP**

| | 2009 | 2008 | 2007 | 2006 | 2005 | 2004 | 2003 | 2002 |
|---|---|---|---|---|---|---|---|---|
| Total | : | 46.8 | 45.7 | 46.3 | 46.9 | 46.9 | 47.3 | 46.7 |
| General public services | : | 6.3 | 6.2 | 6.2 | 6.4 | 6.4 | 6.6 | 6.6 |
| Defence | : | 1.5 | 1.5 | 1.5 | 1.6 | 1.6 | 1.6 | 1.6 |
| Public order and safety | : | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 |
| Economic affairs | : | 4.2 | 3.8 | 3.9 | 3.8 | 3.9 | 3.9 | 3.9 |
| Environment protection | : | 0.8 | 0.8 | 0.8 | 0.7 | 0.7 | 0.7 | 0.7 |
| Housing and community amenities | : | 1.0 | 1.0 | 1.0 | 1.1 | 1.1 | 1.1 | 1.0 |
| Health | : | 6.9 | 6.7 | 6.8 | 6.7 | 6.6 | 6.5 | 6.4 |
| Recreation, culture and religion | : | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| Education | : | 5.2 | 5.1 | 5.2 | 5.3 | 5.2 | 5.3 | 5.3 |
| Social protection | : | 18.2 | 17.8 | 18.2 | 18.5 | 18.6 | 18.7 | 18.4 |

Source: Eurostat database on government finance statistics, Extraction date 2010-10-06

Table 5 on the other hand show how many disasters have been registered in EU27 countries at 10-year intervals between 1970 and 2010. The table show that each category of events has a high variation indicating the difficulty of establishing a sound forecast of coming events. In terms of adapting to climate events the cost estimates could still show if the estimates are reasonable for the number of events a specific year that they are targeting.

In terms of collecting expenditure statistics of adaptation broken down into the same categories as seen in Table 4, one would be able to say how much had been spent on adapting to flooding through dams or dikes during a certain year and match that information to the actual number of events that

same year. Without making the direct link to particular measures, it would indicate the response to climatic events.

**Table 5**
**Number of disasters by EU27* and year**

| | 2010 | 2000 | 1990 | 1980 | 1970 |
|---|---|---|---|---|---|
| Drought | .. | 2 | 2 | 1 | 3 |
| Epidemic | .. | 2 | .. | .. | .. |
| Extreme temperature | 2 | 5 | 1 | .. | .. |
| Flood | 7 | 22 | 0 | 3 | .. |
| Mass movement dry | .. | .. | .. | .. | 1 |
| Mass movement wet | .. | 2 | 1 | .. | 1 |
| Storm | 5 | 10 | 60 | 1 | 1 |
| Wildfire | .. | 5 | 2 | .. | .. |
| Total | 14 | 48 | 66 | 5 | 6 |

*Not all countries had events at these specific points in time and have therefore nothing to report.
Source: EM-DAT. Extraction date 2010-10-06

It was a wish of the European Commission to continue the typology proposed in the White Paper Impact Assessment related to grey and green infrastructures and soft non-structural approaches. Very specific analysis would be required for that typology to be used by anyone else other than the people most involved in following the directions and strategies related to adaptation within the European Commission. The typology would also require additional efforts trying to link other relevant economic or social data. Another approach is that the European Commission themselves, after data collection according to standard classifications, apply the grey/green infrastructure approach. However, by doing so, their analysis would be hampered by the possibility of errors. It would relate to, for example, the main share of grey or green measures in one specific category to be skewed. One example would be in, for example, the agricultural sector. This report has labelled the agriculture sector as green even though irrigation systems are regarded as grey and highly likely to be implemented. It could be that the expenditure for irrigation is higher than the costs for crop diversification.

With regards to the "soft" non-structural approaches (measures) expenditure statistics would not capture these. As these measures cover activities such as developing regulations, taxation and information platforms these are either part of everyday business for a government or not considered expenditure but revenue. In relation to cost estimates the situation is largely the same but with the consequence that if legislation activities are included as a cost, would the work of not conducting a regulation then be seen as a benefit? It is not likely that government activities in relation to "soft" non-structural approaches would be included in cost estimates for some time yet.

# 4. A Proposed methodology for adaptation expenditure statistics

## Summary of findings

It was anticipated that the data review would show that specific adaptation measures in state budgets are not easily distinguished today and this proved correct. If annual monitoring of expenditure for adaptation is to be undertaken we propose the establishment of a new data collection system based on sound statistical principles.

This proposal is not for collecting data on cost estimates (future anticipated costs) but for collecting data on expenditure statistics (past events). The proposal only covers data collection for government statistics. However, it is foreseen that it would be important to also collect data on private measures and a path forward in that area is also briefly described. It is based on a proposal that the Eurostat will be the coordinator of any new statistics on adaptation expenditure and that they co-operate with the European Statistical System to collect the data. This will ensure that the data compiled at country level is harmonised, follows the overall guidelines and facilitates the analytical results to be published.

The authors of this report contend that in order to be able to create the right basis for statistical data collection, the definition of an adaptation measure should follow the IPCC definition. This means that the adaptation measure to be selected should consider elements of the IPCC definition. The authors also believe that the classification of COFOG would provide a good start for collecting data on government expenditure while the NACE classification would provide an excellent basis for collecting data on autonomous measures (enterprise statistics). These classifications would be complemented by a specific table presenting the data on adaptation expenditure according to climatic event.

The underlying statistical process for gathering and presenting harmonised adaptation expenditure data could follow the framework of the UNECE/OECD/Eurostat, known as the Generic Statistical Business Process Model (GSBPM) as seen in Figure 8. The model, or nationally adapted versions of the model, has already been implemented in many countries in Europe. It assists the national statistical offices in compiling existing or new statistics according to a certain set of quality criteria.

The System of Integrated Environmental and Economic Accounts (SEEA), a statistical framework, is proposed for use as the content-related framework when compiling new statistics on climate change adaptation expenditures. Today Eurostat collects several statistical modules within the framework, including for air emissions by industry, environmentally-related taxes and environmental protection expenditures.

This year the European Commission has put forward a proposal to the Council and Parliament to include parts of the area of Environmental Accounts in a Council Regulation. This means that a specific data collection routine would be operationalised, harmonised and published by the EU

Member States and Eurostat. Thus, preparatory actions for this option should include a dialogue with Member States' management authorities (or potentially through a dedicated Adaptation Committee), climate experts, exchange of information (maybe through a platform consolidating the information available), training, improved use of existing programme management control and monitoring tools. The process of including a new statistical field under legislation is normally long and new legislative acts benefit from pre-testing by a large number of countries to support the idea of increasing the response burden of countries, enterprises or the public.

## 4.1 Introduction

There is an abundance of data available today for all and everyone to use, often for free through databases or through published reports. National statistical offices have, as a response to this situation become more aware of the importance of expressing the ideas, theories and applied sciences more transparently than before. As a result single countries have developed programmes and processes to ensure and better describe the process behind the work of producing statistics. Very recently the UNECE[14], the OECD[15] and Eurostat[16] approved a new business model that sets out the path for any statistical process to take. For the statistical community the process model is familiar but nonetheless important to communicate.

It is recognised that there are limits to what statistics can accomplish. We argue that it would not be advisable to standardise data collection in relation to some parameters, including cost estimates, but rather to focus on comparable data inputs. Reporting requirements through the European Commission could be used to help statistical data gathering undertaken by national statistics offices. Underlying data related to cost estimates could be provided by the statistical community to some extent, where confidentiality is not an issue or where there is a mutual cooperation between the research community and the statistical offices.

The proposed methodology in this report is based on existing statistical standards. The overall statistical framework that applies to national statistical offices is the Generic Statistical Business Model (GSBPM). It assists in such a way as to ensure that the compilation of statistics follows certain steps, like a checklist and verifies the quality of published results. The second statistical framework, more related to the topic, that could be followed is the System of Integrated Environmental and Economic Accounts (SEEA). This is a statistical system that enables a link between economic statistics and environmental statistics. Each step of the GSBPM is explained on a theoretical level implementing the SEEA while Chapter 9.11 in the full report also presents an example of how the statistical compilation could look based on Sweden.

[14] The United Nations Economic Commission for Europe

[15] Organisation for Economic Co-operation and Development

[16] The Statistical Office of the European Union

## 4.2 A general statistical framework for data collection

Statistical compilations build on a number of principles and processes. Each new survey benefits from the experience of previous knowledge and expertise. In order to systemise the work with a global effect, an initiative was taken by the UNECE, the OECD and Eurostat to develop a generic model that could be accepted worldwide. Based on an existing business model from New Zealand's statistical office, a Generic Statistical Business Process Model (GSBPM) has been developed (the full model is available in Annex 3). The Common Metadata Framework was published in 2009.

The model is intended to apply to statistical production regardless of the data source (surveys, administrative records, data integration etc.). It also encompasses data quality and the production of metadata. The model introduces the aspect of agreement on standardised higher levels, but provides freedom for individual organisations to introduce lower levels aligned to their specific needs. This is similar to the way that some international statistical classifications are managed.

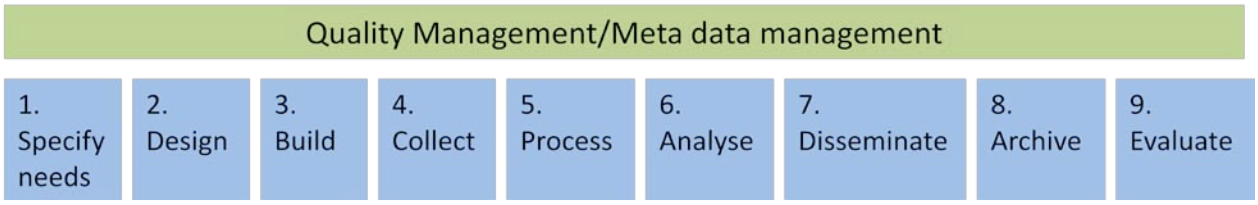
Globally, the model has been adapted or adjusted to existing models around the world. It already provides a basis for the standardisation and benchmarking of production processes, and harmonisation of terminology. (Eurostat 2010).

The GSBPM consists of four levels:

- Level 0, the statistical business process;
- Level 1, the nine phases of the statistical business process;
- Level 2, the sub-processes within each phase;
- Level 3, a description of those sub-processes.

The underlying process modelling theory claims that each sub-process should have a number of clearly identified attributes depending on the issue at hand. These attributes cover e.g. inputs, outputs, purpose, owner, guides, and feedback loops or mechanisms.

**Figure 5**
**The Generic Statistical Business Process Model**




Source: The Joint UNECE/Eurostat/OECD Work Session on Statistical Metadata (METIS)

**The example of creating new statistics on adaptation expenditure**
The GSBPM is not a linear model but a matrix. The matrix allows many possible paths, including iterative loops within and between phases. (UNECE 2009). However, the overall process as seen in Figure 5 shows the intended work process. In the work of creating a new statistical domain of "adaptation" it is important to specify and adhere to the needs of the user community (Process 1). In Process 2, one would thereafter continue to design the method of data collection, might it be a new questionnaire-based survey or to identify other administrative sources. The third component

"Build" indicates that the supporting IT systems and the production systems need to be developed. The fourth process would then follow: to actually collect the statistics. Processing the results under the fifth item contains such activities as quality assurance, coding, the derivation of variables and calculating the end results. The sixth process then contains the work of explaining and validating the final outputs. With statistics it is also important to apply disclosure control which is included under this process. The seventh process contains dissemination of results and promotion activities. Towards the end of the process the results and work process are archived and later on an evaluation of the whole project is conducted. That is when the iterative process becomes important and specific sections are returned to in order to ensure improvements the next time the survey is carried out.

## 4.3 The System of Integrated Environmental and Economic Accounts (SEEA)

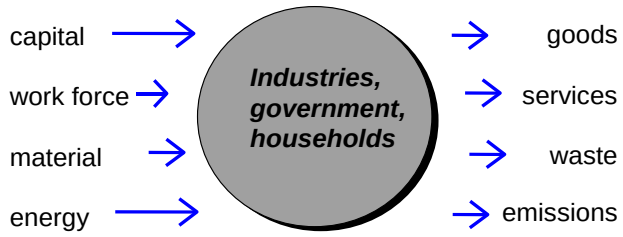
The System of Integrated Environmental and Economic Accounts (SEEA) is a statistical information system that links environmentally relevant data with statistics on economics through the System of the National Accounts (SNA 2008). This means that the definitions, guidelines and practical approaches of the SNA are applied to the SEEA. In broad terms, the system can be described as enabling any user of statistics to compare environmental issues to general economics, knowing that the comparisons are based on the same entities, for example, pollution levels caused by a producing industry can be linked to the specific economics of that industry.

The SEEA has been developed since the early 1990s and has proven to complement normal environmental statistics with policy-relevant economic information. The economic information found in the SNA can be used in many ways: one major indicator from this system is the Gross Domestic Product (GDP).

The SEEA aligns economic and environmental statistics in the same industrial and sectoral breakdowns. This enables the information to be used in environmental economic models, such as CGE-models and econometric models. For climate change, it has mainly been the economy and greenhouse gas emissions that have been the key point of analysis. With this project, the focus is instead on the economic transactions of the state for the purpose of climate adaptation. However, the system allows for expansion to autonomous measures quite easily if this is needed.

The accounts register the structure of production and consumption in society and identify the economic actors and their transactions. One of the economic actors in the accounts is the state. The accounts register how the state spends its money, which economic actors it buys from and for what purposes.

**Figure 6**
**The main statistical components included in the System of Integrated Environmental and Economic Accounts (SEEA).**



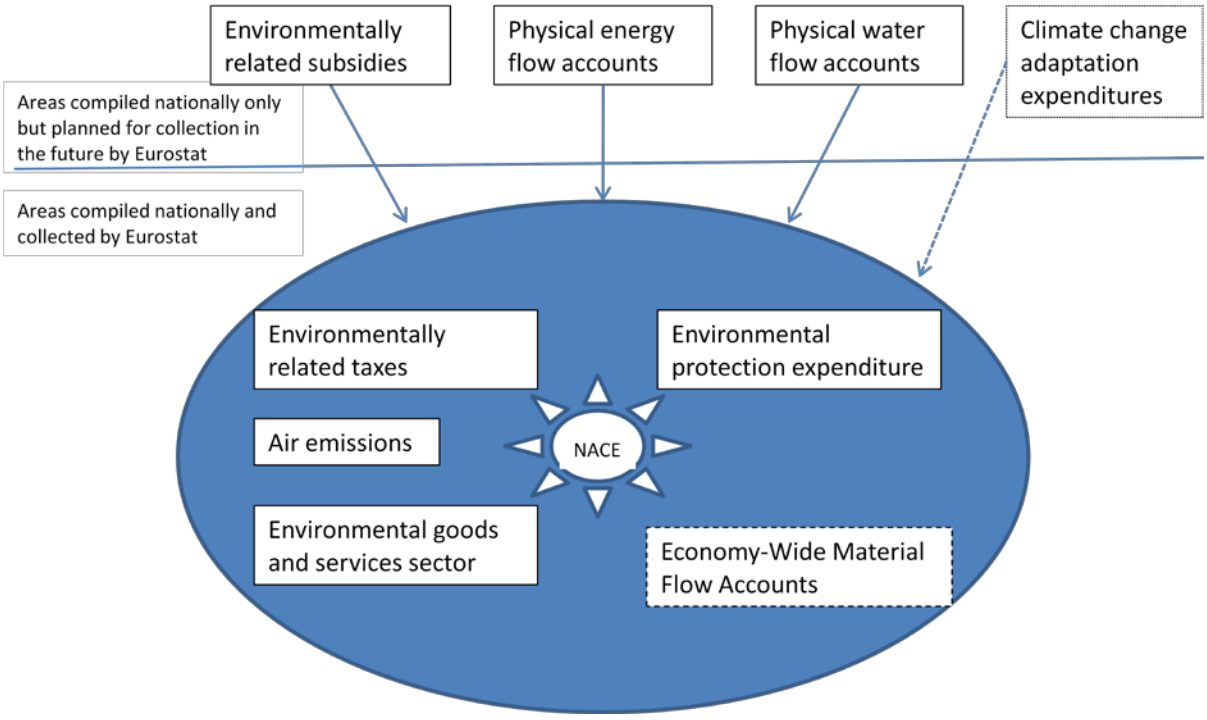

On an EU level, the national developmental work of the SEEA and the SNA is coordinated by Eurostat.

This system is well equipped to incorporate new, environmentally-related expenditure statistics. Under the auspices of Eurostat, a data collection procedure could be developed to suit the European Commission. The first steps have already been taken with the creation of the Reflection Group mentioned above in Chapter 1.

Today Eurostat collects several components of statistical areas under the framework of SEEA. The areas cover both monetary type environmental economic statistic such as taxes and investments but also physical environmental statistics such as air emissions as seen in figure 7. The common denominator for all different components is that they are broken down by industry (NACE) with the exception of economy-wide material flow accounts that focus on the economy as a whole.

Certain components of the SEEA are only compiled at national level. However, Eurostat is currently working on increasing the data collection at EU level and data on climate change adaptation expenditures could be one such component in the future.

**Figure 7**
**Statistics already collected by Eurostat or planned for collection in the future**




Below follows a theoretical application of the two systems, the GSBPM and the SEEA.

## 4.4 Step 1: Specifying the needs

Through the constant flow of questionnaires, data collections and interviews, it has become increasingly important to provide solid reasoning when establishing new statistics. Response burdens should not be increased but reduced, the use of existing data sources are encouraged and each proposal to create something new undergoes close scrutiny by authorities, organisations and the respondents.

In order to establish new statistics on adaptation it is therefore important to specify the needs of the organisation requesting the data. For this specific topic one would say that the European Commission has a need to follow up the strategies set up at EU level. But this might not always be sufficient to ensure that national statistical authorities are provided with the necessary resources. It is therefore important to follow the national developments in strategising the field. In most strategies there is often room for improvements when it comes to indicators and ex-post evaluations.

Besides the needs of the user, this step also includes identifying the scope, concepts and output objectives.

**The specific framework under which adaptation expenditure could fit**
The overarching concept under which new statistics on climate change adaptation expenditure could fit would be the System of Integrated Environmental and Economic Accounts. By following the different approaches, guidelines and the existing international cooperation in the area statistics of international comparability would be ensured.

With respect to adaptation expenditures, one would have to focus on the measures and activities on the existing system boundaries of, in particular, the residential principle. This means that the economic actor who is performing the activity or is financing the activity should be measured. Within economic statistics this is not difficult, the enterprise or establishment located in a specific nation is also the entity on which the statistics are based.

Things are rather different if one turns to traditional environmental statistics where it is more common to follow the national boundaries rather than the economic actor.

It would be expected that the national statistical offices would implement the developed methodology for adaptation expenditures within their work on SEEA and that Eurostat would then collect the published statistics on aggregate levels.

**Defining the scope based on the IPCC definition of an adaptation measure**
The term "Adaptation" must be defined in order to conceptualise this new statistical field. The decision to choose a particular existing definition must be clear and acceptable for the community working on the topic area as well as understandable by the end-user community.

In our opinion, the preferred definition would be that of the IPCC. To recapitulate the definition: Adaptation is defined as "adjustment in natural or human systems in response to actual or expected climate stimuli or their effects, which moderates harm or exploits beneficial opportunities associated with climate change."

This definition has the advantage of identifying the intention of responding to climate change, which can be connected to the budget lines and their motivation. It does not presume that the effect of the measures has to be evaluated before a classification can be done. In previous work with other environmental economic statistics it has been argued that compiling statistics based on the motive of an expense is more straightforward compared with definitions based on effect. Determining an effect of an expense is actually a second step in the analytical chain and often involves assumptions on reference scenarios. First, one needs to know how much has been invested as an intended measurement. Thereafter, researchers are able, on the basis of available information, to compare actual expenses with impacts or effects of the measurement (Palm et. al, 2009). This is one reason why the "response to actual or expected climate stimuli or their effects" is a good candidate for future data collection. Another reason for this definition to be applicable is that it is widely used in reference literature and understood by most actors. However, it is still needed for the definition to be tested more broadly on statistical compilations and not only within a specific research study.

By testing the definition, guidelines can be further developed in order for the compilation to become more streamlined and comparable across countries. The testing would be done at country level and assessed by the statistical community and thereby provide good examples and ideas on how to apply the definition. It is important that the measures are not arbitrarily assigned to the adaptation area.

One topic/boundary issue is related to whether or not expenditures for occurred damages could be seen to be included in the definition. The definition describes adjustments to actual or expected events. One could see expenditures for damage or remediation as an acceptance rather than an adjustment and would therefore not be included.

## 4.5 Step 2: Design

The second building block according to the GSBPM is to start designing the questions/variables of interest for the data collection and the data collection methodology itself.

The production of government-based statistics is currently based on administrative data. Very few countries perform questionnaire-based surveys but instead rely on official documents and registers to compile statistics. However, if autonomous measures (private actions) had been part of this project, this section would have described alternative ways of constructing sample-based surveys.

This project has however only looked at planned measures and therefore been constructed following the approach of collecting relevant variables and then examining how a new set of tables could be constructed. The idea is that national statistical offices or another relevant authority should compile the necessary information based on the details they can retrieve from their statistical sources. After which the European Commission, namely Eurostat, would send out the proposed tables below to the national counterparts and thereby collect the statistics to be analysed at an EU level.

**Proposing a hierarchy of statistical tables**

Based on the first evaluation of the list of measures, the data collection exercise and our discussion with the Eurostat Reflection Group, three different types of tables are proposed. They could be used as a data collection tool by the European Commission to be sent to the Member States and the European Statistical System. The individual countries would have the basic data and aggregate the information to suit the tables.

In general all financial flow within the government would be recorded that has bearing on adaptation. This also means that funding mechanisms to the third world would be included in the data. With regards to in-flow to the economy through different EU funds, this would not be captured by the proposed tables as it is not considered an expenditure by the government. In case the European Commission also wants to follow revenues on adaptation, specific tables would have to be developed. However, it can sometimes be the case that the subsidy or investment grant reported is actually financed through different EU programmes. It would be important to clarify this in the event of an actual reporting mechanism in the area.

**First level: Total expenditure on adaptation by government level**
The first level of data would be the most aggregated level. It is constructed to calculate total governmental expenditure for adaptation. The idea is that countries report the statistics they have gathered that fit in Table A below, issued by Eurostat. Table A consists of the basic variables collected through governmental finances statistics and would be fully comparable to other macroeconomic aggregates such as GDP, output or similar. The table is also broken down by institutional sector. It is anticipated that certain variables would be of minor significance such as property income or that even Social security funds would have very little to do with adaptation measures but it is nonetheless part of the total calculation.

**Table A**
**Total expenditure for adaptation, Year X**

| Type of financial flow | State | Central | Local | Social security funds |
|---|---|---|---|---|
| Gross capital formation + Acquisitions less disposals of non-financial non-produced assets (transaction OP5AK2) | | | | |
| Subsidies (D3) | | | | |
| Property income (D4) | | | | |
| Intermediate consumption (P2) | | | | |
| Other taxes on production + Current taxes on income, wealth, etc.+ Adjustment for the change in net equity of households in pension funds reserves (OEB) | | | | |
| Total expenditure of functions of government | | | | |

**Second level: Expenditure for adaptation by COFOG and government level**
Table A1 would be in addition to Table A, providing additional information presented a little differently. The total sums would be equal to those of Table A. The reason for creating such a table as seen in A1 is that different analytical conclusions can be drawn from the tables even though the basic information is the same. Normally the data collected by Eurostat from the European countries through COFOG are divided into institutional sector **and** type of financial flow **and** by type of function. However, as adaptation expenditures are in their infancy, it is not expected that the statistics could actually be this detailed so soon. To separate them would enable a country to fill in at least one of the two tables.

It is important to note that only the adaptation expenditure for adjusting behaviour is included but not damage and remediation expenditure.

The table only shows an extract of the domains available. Under Category 04, Economic affairs, more sub-categories are available such as e.g. communication, or R&D. The same applies to, for example, Category 06 where Water supply is included as a separate sub-section. See Annex 2 for a full list of sub-categories that are included in the COFOG.

**Table A1**
**Expenditure for climate change adaptation. Part of table A (COFOG), Year X**

| Government functions | State | Central | Local | Social security funds |
|---|---|---|---|---|
| 01 General public services | | | | |
| 02 Defence | | | | |
| 03 Public order and safety | | | | |
| 04 Economic affairs | | | | |
| *Of which:* | | | | |
| *04.2 - Agriculture, forestry, fishing and hunting* | | | | |
| *04.3 - Fuel and energy* | | | | |
| *04.4 - Mining, manufacturing and construction* | | | | |
| *04.5 – Transport* | | | | |
| 05 Environmental protection | | | | |
| *Of which* | | | | |
| *05.1 - Waste management* | | | | |
| *05.2 - Waste water management* | | | | |
| *05.3 - Pollution abatement* | | | | |
| *05.4 - Protection of biodiversity and landscape* | | | | |
| 06 Housing and community amenities | | | | |
| 07 Health | | | | |
| 08 Recreation, culture and religion | | | | |
| Total | | | | |

**Third level: Expenditure on adaptation by type of weather event**
The third level of tables would break each specific topic down into special analysis depending on climatic events and type of financial flow. From the design point of view Table A1.1 is a hybrid of Tables A and A1 as it combines type of event with type of financial flow rather than by institutional sector. It is of course possible to develop two different sets of tables just like the one above. However, the main finances for disaster prevention measures by the public sector would go through the state and a total would probably suffice. Table A1.1 is a sub-set of information to Tables A and A1. This means that only measures directed at disaster prevention would be recorded. In Tables A and A1 other types of measures like green corridors or diversification of crops would be recorded as well as disaster prevention measures. As the data collection review revealed, most countries consider adaptation to be directly linked to weather types and report data by type of event rather than by sector of the economy, e.g. building dikes to prevent flooding or changing irrigation practices because of water scarcity. It would therefore be important to be able to follow this scenario as well as being prepared for the fact that this table might be the one where most information is available today.

**Table A1.1**
**The direct disaster prevention expenditure. Part of table A and A1. →**
**Purpose: reduction of impact, Year X, general government**

| Type of economic flow / Type of weather event | Investment | Intermediate consumption | Subsidies/ investment grants | Co-operation funding |
|---|---|---|---|---|
| DDP.1. Storms | | | | |
| DDP.2. Floods | | | | |
| DDP.3. Extreme temperature<br>*Of which* | | | | |
| *DDP.3.1 Heatwave* | | | | |
| *DDP.3.2 Cold wave (Frost)* | | | | |
| *DDP.3.3 Extreme winter conditions (Snow, icing, rain, avalanches etc.)* | | | | |
| DDP.4. Drought | | | | |
| DDP.5. Wild fires (forest, grass, shrub etc. ) | | | | |
| DDP. Epidemic (viral-, bacterial-, parasitic infectious diseases etc) | | | | |
| DDP7. Other | | | | |
| Total | | | | |

## 4.6 Step 3: Build

The third step is more related to constructing an internal workflow for effective data collection. The building component also includes testing of the production system.

As mentioned above, the idea is that Eurostat should continue to develop the design of the proposed tables, to further develop the guidelines on how to apply the concepts, definitions and classifications. This would enable the European countries and the national statistical offices to compile statistics ensuring international harmonisation of results and statistics of good quality.

Eurostat and the national statistical offices equally, would have to develop a work process that enables efficient and expedient handling of the data gathering. This involves establishing a process for the handling of incoming data, i.e. how can data be stored and be validated, another process for how to best apply the information gathered to the appropriate means of transforming data to the tables and finally how to transfer data from the national statistical offices to Eurostat.

## 4.7 Step 4: Identify and collect

Step four relates to setting up the sample (if the statistics are compiled according to questionnaire-based approaches), setting up the data collection and performing the data collection.

In relation to government finance statistics the procedure would rather be to identify the existing administrative source, i.e. government budgets or specific database containing governmental outlays in which to identify adaptation measures and thereafter collect the data.

With regard to pinpointing how much extra is spent on adapting to climate events it is proposed to follow the approach already set up by Eurostat in the field of environmental protection expenditures. This project proposes an adjusted model that is mostly applicable to enterprise-based statistics but could be a guideline even for planned measures as seen in Figure 8. This proposal was also recommended by the Eurostat Reflection Group as an initial step forward.

The following text is adapted from Eurostat 2005 publication on environmental protection expenditures – industry data collection handbook. The approach builds on a series of questions where the answer is either yes/no/all other cases. The aim is to try and think of what type of measures have been carried out during the past year to adjust to climate change. This will produce a rough list of measures to be considered when filling in the tables (Question 1 in the tree). The purpose of the following questions is to identify different types of measure involving different types of cost estimations.

The second aim is to identify measures where the main function is adaptation to climate change and the total expenditure would be reported regardless of the driving force.

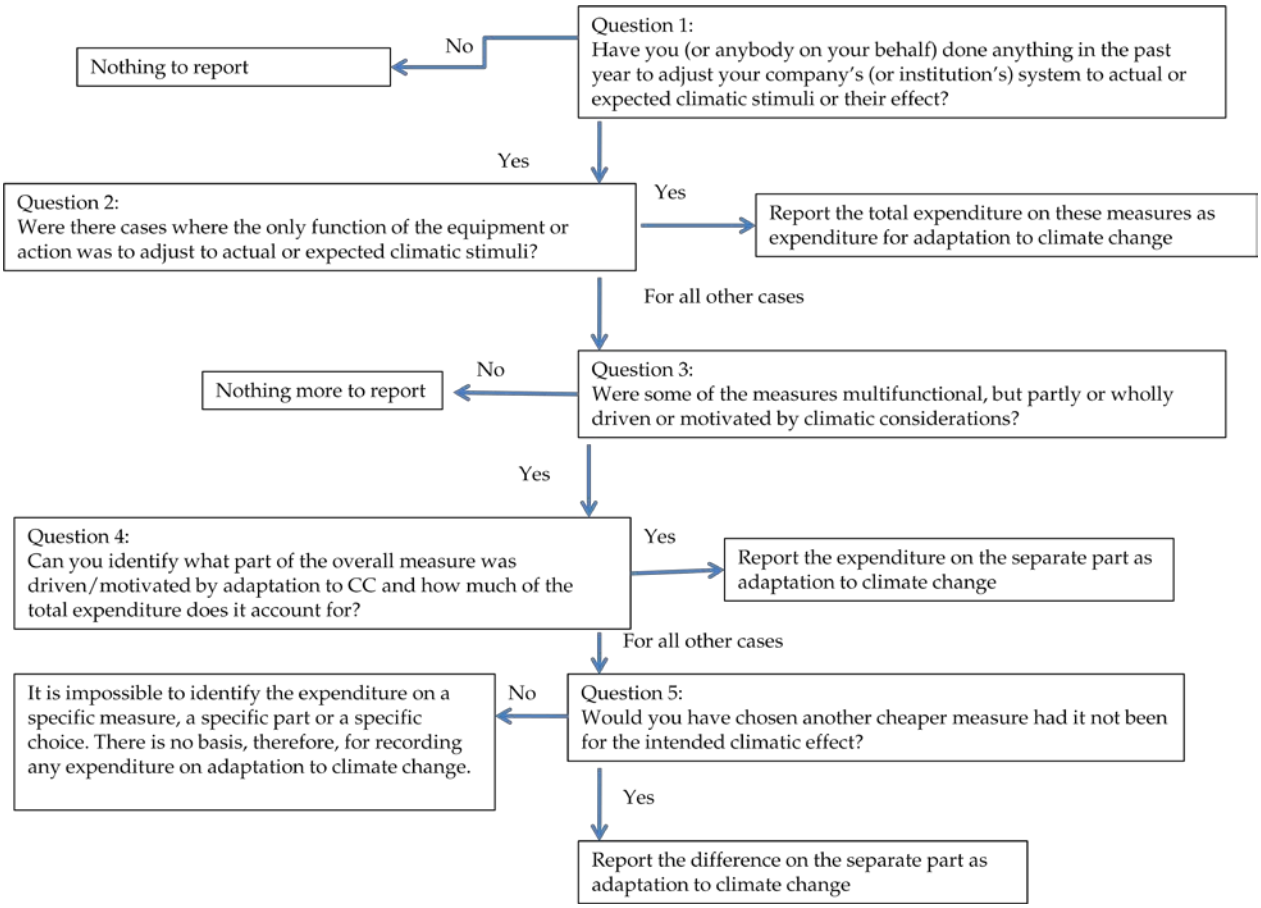
The third aim is to ensure that the remaining measures on the list, i.e. multifunctional activities need to be identified. There are three possibilities for evaluating adaptation expenditure for such measures.

- The first is to identify a separate part that accounts for the adaptation effects and to estimate the expenditure for this separate part (Question 4).

- The second is to identify an extra amount spent related to a specific choice. In this case the extra cost compared to the alternative without the intended adaptation effects would be reported as adaptation expenditure (Question 5).

There will inevitably be some measures that have improved the adaptation capacity but where no climate change adaptation expenditure can be reported. It is important to avoid giving the impression that we would like an adaptation component for all types of activities. That would result either in too high figures, mostly based on a rule of thumb, or a refusal to answer because the response burden was thought to be unacceptable. It is also important to explain that the reason for not including these measures is not that they are unimportant, but rather that they are so integrated into the normal operating activity of the business or government agency that it is impossible to identify them as climate change adaptation expenditure.

**Figure 8**
**Proposed guideline for determining the part of expenditures specifically dedicated to adaptation measures**




## 4.8 Step 5: Process

The process of the resulting data collection would then follow. This would entail ensuring the correct coding and classification allocation. It would also include validating the basic data. Normally the approach is to look at the previous year's data for the same measure (if it exists on an annual basis) to ensure that no typing errors or erratic behaviour of the data are present in the micro-data material.

The process step also includes summarising the material into selected aggregates. This is when the tables developed for Step 2 would be used.

## 4.9 Step 6: Analyse

The sixth step includes the process of preparing the draft outputs, explaining the results as seen, and validating the aggregates.

The basic results would be validated through other macro-aggregates. For example; if the tables are constructed by COFOG, other COFOG data could be applied, creating new indicators that would both validate the results (i.e. adaptation expenditure are not larger than total government finances) and

provide interesting indicators that would enhance the analytical possibilities.

If times series are developed, the analysis would describe changes over time and how the data relates to other expenditure in the same area.

## 4.10 Steps 7-9: Disseminate, archive and evaluate

The final three steps relate to how the statistical office would proceed in order to publish the information, how it would archive and manage documentation of the area as well as evaluating the entire procedure, from Step 1 once again for the following data collection cycle.

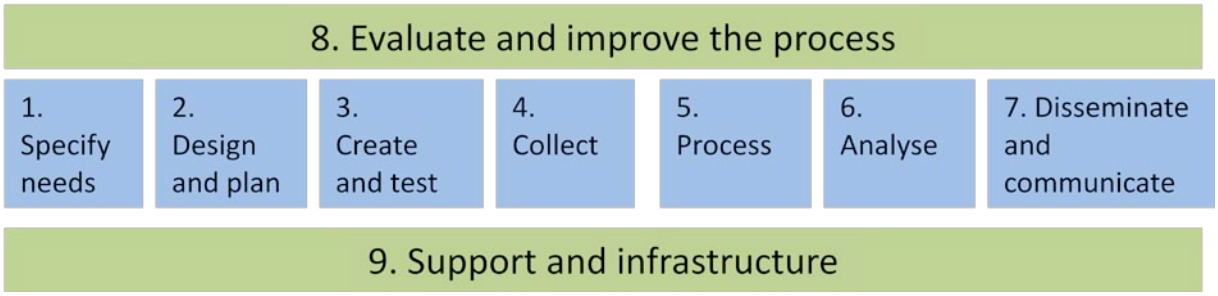
## 4.11 An example of how a country could implement the proposed methodology

Two aspects facilitate this example. The proposed model builds on two frameworks, the GSBPM model and the SEEA. Statistics Sweden has implemented a national version of the GSBPM model as seen in figure 12. The content does not deviate from the international model however is visualised slightly differently. Statistics Sweden has worked on SEEA since 1993 thus knowing the system from a European perspective very well.

The model at Statistics Sweden focuses mainly on survey sample statistics and quite a few of the sub-steps are not applicable to the approach taken in this proposal. As only the public sector is to be evaluated there would be no need to create such things as population frames, samples, enumeration methodologies or statistical confidentiality checks.

The following example follows each of the first 7 steps of figure 9. Steps 8 and 9 are iterative processes throughout the work flow and mentioned where appropriate.

**Figure 9**
**The GSBPM model at Statistics Sweden**




**Step 1: Specify needs**
The Swedish government has expressed an understanding of the regional and local impacts of global climate change in Sweden and articulated in the 5th National Communication to the UNFCCC that work on climate change adaptation has been identified in Sweden since 2005. There is no national follow-up of the actions taken other than the UNFCCC report and the possibility exists that the government would be interested in compiling annual statistics in the field. Contacts would be taken to identify the national needs in order to compile as much relevant information as possible.

The other user of the future statistics would be Eurostat through the data requirement at EU level. It is not likely that national statistics would be compiled without the expressed request from Eurostat to do so.

**Step 2: Design and plan**
If Eurostat applies the proposed tables A, A1 and A1.1, some work has already been done that helps the data-gathering process. However, certain additional tools need to be designed as along with the setting up a plan related to the entire production flow.

As the tables proposed only relates to government expenditures there will be no need to design a population or a sample survey. As a result of this there will be no need to establish methods for estimating missing data or national weights to enumerate survey results. The important aspects are to identify the correct source of administrative information, design the validation procedure to ensure the quality of incoming data, design the analysis to be performed and design the output with regards to publishing and communication.

*Data sources*
In Sweden the Swedish National Financial Management Authority (ESV) coordinates and has the responsibility to collect and disseminate government based statistics. The data they produce is processed according to SNA principles and according to the COFOG classification. The data in its processed form also serves as input data for the calculation of national economic statistics.

With regards to other environmental economic information, such as environmentally motivated subsidies published by Statistics Sweden, the data is processed based on data from the ESV authority directly. The SEEA-group which is responsible for statistics on environmentally motivated subsidies cannot use the processed data from the national accounts group as the level of detail is lost after their aggregations and extra processes.

*Designing validation procedures*
The data from ESV is generally of good quality, but nevertheless certain checks need to be established to verify the information. A simple check is to find the corresponding appropriation in the national budget and verify the calculations. Additional validation could be achieved through establishing contact with the respective government departments and authorities for their input into the extracted data. The procedure would also include comparing the statistics with previous cycles (if applicable).

*Designing the analysis and dissemination*
The analysis of the expected data output would be based on existing approaches in terms of shares and indicators. The tables would be published by COFOG category and totals. In addition, indicators would be created such as total adaptation expenditure as a percentage of total government expenditure. Another indicator that would be interesting to compile would be to use the data on disaster prevention expenditure (table A1.1) and link it to weather events.

*Designing the production flow*
The entire production flow would be planned according to when the basic data is made available and how often Eurostat would require data to be sent to them. Certain milestones would be:

- The availability of basic data from ESV (when T-1 year is usually available),
- The availability of experts in the field,
- The availability of technical support (to build databases or programmes for calculating the results)
- The availability of related data on which indicators can be based on.

**Step 3: Create and test**
It is not expected that the amount of incoming data will be large in terms of number of rows in a work sheet. It is highly likely that the SEEA group at Statistics Sweden would choose Excel as the preferred way of compiling the statistics. A pilot project would have to be launched to test the scoping, the data manipulation and the output results. If the pilot revealed that the data collection procedure could be based on other statistical programmes, such as SAS then a new instrument would be created that provides a more efficient production system.

**Step 4: Collect**
It is probable that data on adaptation expenditure would, in a similar fashion, use the data from the ESV directly as for environmentally motivated subsidies. Relevant COFOG classes would be extracted and further operations would follow. Each line in the budget (i.e. each appropriation) would be examined based on the existing text but also by means of the budget document connected to the data. From previous experience it's known that government budget documents are not detailed enough. On such occasions contacts will be necessary with the relevant authority to establish where the spending has been allocated and to what.

Care must also be taken that no double counting is made with regards to the flow of transfers between central government and local government. The data used within the SEEA-group today from ESV only looks at central government and there might be situations where funding elsewhere has been made.

**Step 5: Process**
Step 5 mainly relates to sample surveys and as this data compilation would not fall under that category this process is fairly simple. As mentioned, there would be a plan for how to validate the data extracted from ESV, see Step 2. The validation would verify the quality of the data and thereby enable robust results.

**Step 6: Analyse**
In this phase, statistics are produced, examined in detail and made ready for dissemination. This phase enables statistical analysts to understand the statistics produced. Analysing the results would entail constructing the tables, indicators and explanations of the relevant aspects of the data.

It would be important to interpret the data, explaining the particulars of adaptation expenditures.

**Step 7: Disseminate and communicate**
This would be the last phase of the production process (besides the evaluation process that follows each new release of statistics). This involves formatting and loading data and metadata (documentation) for publication in the available databases on-line. In addition to the explanatory texts, tables and graphs will be prepared along with press releases to promote the new results.

Statistics Sweden will publish all results on-line free of charge. Data on adaptation expenditure would therefore be available in the Swedish Statistical Database, and have its own place on the website in connection to other SEEA-type statistics.

## 4.12 Conclusions: standard tables and standardised calculations

The EU budget itself is at the moment not adapted to include new statistics related to adaptation expenditure. It requires the attention of Commission officials to suggest changes in the budget layout before adaptation components can be visualised. Until recently there has not been an interest in highlighting adaptation activities and as a result new ways to accomplish this goal need to be considered.

The proposed tables for data collection on expenditure statistics are mainly directed at the national level budgets but the higher aggregated tables could apply also to the EU budget programmes or projects.

With regards to collecting new statistics on adaptation expenditures, it is proposed that Eurostat, as the coordinator of SEEA in Europe, should take the lead in the further work. Eurostat have already established work processes and mechanisms for co-opting national experts in statistics and policy related areas for discussions. They also have the systems developed to handle data collection, validation of results and dissemination. On the national level, the national statistical offices or equivalent have established routines to handle new data requests from Eurostat and balance them with national requirements.

It is seen that standardised tools are required to gather new information on adaptation to climate events. The proposal is therefore that either DG Clima themselves propose a new data collection in the field or provide Eurostat with the incentive to carry out the work.

# 5. Conclusions and possible ways forward

This project focussed on government measures for adapting to climate change. The goal was to propose a system to standardise data flows for the measurement and ex-post monitoring of economic data of adaptation as well as how to calculate adaptation costs. The report focuses on two relevant aspects: quantifying the cost of adaptation, and expenditure on adaptation. Regarding expenditure on adaptation, the report proposes a new methodology to quantify adaptation expenditure through the compilation of new statistics. It describes how the EU is currently accounting for past spending on adaptation in its budget, examines whether EU Member States hold any statistics on how much they have spent on adaptation, and if this is the case, what types of measures are included as part of these statistics.

The project has only looked at planned measures (i.e. government activities). Aspects related to autonomous measures (i.e. private activities) are not covered as part of this report.

## 5.1 Project results – specifics

**Defining the scope, checkpoints and typologies**
In order to establish the scope and boundaries for adaptation expenditures and adaptation costs, the project investigated the available literature for guidance. Several definitions, approaches and practical applications were identified. The IPCC definition to be applied when scoping the area out is already internationally recognised. What is missing is a widespread testing of the definition involving a critical appraisal as to the kinds of measures and activities that can be considered as falling under the definition.

In order to guide the person who will compile the statistics on adaptation a checklist developed by Eurostat is proposed. The checklist is adjusted to adaptation and it guides the compiler with a set of questions to determine the applicability of a specific measure to adaptation.

The project also investigated existing typologies and ways of categorising the final results of the different calculations. Throughout available studies certain sectors were always studied: agriculture, biodiversity, forestry, water and health among others. It did appear possible to apply standard statistical classifications to the area and for this project. Considering that the public sector was the targeted sector for investigation here, the Classification of Functions of Government (COFOG) is proposed for use as the future typology.

From a statistical point of view the typology aims at consistently categorising items so that adaptation measures do not blend into one another. But more than that, it provides a framework to which additional information can be added to enhance a specific study or project, if applied correctly.

**Identifying the current situation on data availability**
The review initially started out with a review of international and national budgets but this quickly proved futile. Most budgetary allocations are related to broad programmes containing a large variety of headings unrelated to adaptation. This was not unexpected. Even though discussions at policy levels are increasing it is generally the case that the development of indicators and data is of secondary concern and tends to follow a few years behind policy developments.

This said, with the correct application of the definition and access to detailed records of actions, implemented measures and distributed resources data could be made available. If, for example, a country is establishing a climate change adaptation policy with instructions on what type of measures should be dealt with, it is possible to investigate the actual implementation of said actions and, hopefully, financial records are kept that can be used.

**Proposing a methodology to compile statistics on adaptation expenditure**
Public sector expenditures are today compiled statistically through the System of National Accounts (SNA) to capture one nation's commitment in a wide range of issues. Specific governmental expenditures on environmental protection are compiled according to the System of Integrated Environmental and Economic Accounts (SEEA), a sub-set of the SNA and both systems are co-ordinated in Europe by Eurostat.

For government spending on adaptation the proposed methodology follows the SEEA in concept, boundary issues and applications. This will ensure international harmonisation of the compiled statistics as well working with a platform that already has channels and mechanisms established to work on improvements of the proposed methodology. The added benefit of following the SEEA is that the framework enables traditional economic statistics to be linked to the new information and it is possible to analyse adaptation expenditures against other economic commitments. This enables the reader of the final results to grasp the relative size of the expenditures on adaptation and compare them to other fields of interests.

In brief, the methodology follows a work process model, the Generic Statistical Business Process Model (GSBPM). This model supports the development of new statistics from design of tables and questionnaires to processing incoming data and presenting the results. It can be applied to both national organisations as well as supranational organisations.

## 5.2 The proposed path forward

The project emphasises the need for testing the developed proposals of this study. Even though the work builds fully on existing approaches and methodologies, the standardisation process always takes time. By testing the proposals, adjustments and improvements can be made in order to provide the maximum possible benefits in the form of reliable results and credible platforms.

The project proposes that Eurostat continues the work on establishing a new statistical area on adaptation expenditure in cooperation with DG Clima and relevant experts at other DGs. By doing so the policy relevance of the compiled statistics would be ensured.

A result of their efforts would be that harmonised guidelines and approaches can be established for the national statistical offices to apply in their part of this process. From the literature review it was clear that detailed access to national information is needed to create statistics of good quality. For that reason it is not feasible for the European Commission to gather the data themselves without assistance from national organisations. As such, Eurostat has the responsibility to coordinate this need and work.

DG Clima could lobby for the area of expenditure on adaptation to become part of the future statistical EU regulation on Environmental Accounts. With respect to adaptation cost, DG Clima could consider developing a set of cost assessment guidelines that could be used by stakeholders throughout the EU.

# Annexes

## Annex 1: Typology of the White Paper

Commission staff working document accompanying the White Paper Adapting to climate change: Towards a European framework for action - Impact assessment SEC(2009)387 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=SEC:2009:0387:FIN:EN:PDF

| No | Category A | Description | Comments related to typ. Issues catA | Category B | Description (from page 29) | Comments related to typ. Issues cat.B |
|---|---|---|---|---|---|---|
| 1 | Biodiversity | Ensuring high diversity in species, compliance checks into spatial planning, strenghten nature conservation measures table 5, p.66 | The description focus on biodiversity issues, and does not include measures directed at economic entitites. | Grey infrastructure | Not applicable? | Green infrastructure here mixes agricultural production issues with biodiversity issues. Pest infestations to crop is perhaps more important to the production per se rather than the ecosystem at large. |
| | | | | Green infrastructure | Preserving biodiversity and ecosystems. Integrated agriculture systems with a diversity of crops and surrounding ecological zones can provide strong defences in the face of weather extremes, pest infestations and invasive species. Wetland manag. enables plants and animals to survive. | |
| | | | | Soft non-structural appr. | Information gathering, supportive institutional or social frameworks to increase resilliance of biodiversity | |
| 2 | Water | Desalinisation, addressing flood risks, water demand management, ensure stable water cycles, technological measures to help soil infiltration, anti-erosion measures etc. Table 6p.69 | Anti-erosion measures in this group resembles soil managment cat.A, number 3 | Grey infrastructure | Targeting a degree of control over the environmental threat itself e.g. flood control, dams, dikes. Levees | Good correspondance of both cat 1 Water and the grey/green/soft measures |
| | | | | Green infrastructure | Improving infiltration and retention of water into the soil and progressing towards soil saturation helps restoring ground-and surface water resourc. | |
| | | | | Soft non-structural appr. | Water taxes or fees for water services, information, education in relation to water managment and risk management, water regulations | |
| 3 | Soil and land use | Flooding, reducing loss of organic matter by adapting existing cultivation practises, soil improvers/fertilisers, control erosion, control salinisation, change crops to halt loss of biodiversity. Table 7p.74 (only land use, no description for soil) | Speaks more of agriculture specific measures and biodiversity Cat. A no 1 and also contain flooding issues of Cat.A no 2 "water" | Grey infrastructure | Targeting a degree of control over the environmental threat itself e.g. flood control, dams, dikes. Levees | The grey/green infrastructure appears to cover similar types of measures, especially regarding risk/control of flooding |
| | | | | Green infrastructure | Wetland management that creates natural barriers that allow managing increasing water flow, floods, storms | |
| | | | | Soft non-structural appr. | Regulation for agriculture practises, taxes on fertilizers, information | |
| 4 | Agriculture | Changes in land use/management, irrigation practises, crop changes , reduce/avoid soil degradation (loss of organic matter, erosion, salinisation) by adapting existing cultivation practises (ploughing in crop residues, using green | Appears to adress only economic aspects of agriculture. It could be interpreted to include measures aimed at reduce soil/degradation but it does not clarify if it has to do with production or soil protection | Grey infrastructure | Increased irrigation | Interesting that irrigation is seen as a grey infrastructure in the WPA and not a green. |
| | | | | Green infrastructure | Integrated agriculture systems with a diversity of crops and surrounding ecological zones | |
| | | | | Soft non-structural appr. | Subsidies for crop changes, or production practises. | |
| 5 | Forests | Reforestation and reconstruction after large storms, reducing habitat fragmentation to increase resilliance of forest, diversified species and age structure, chainging land use to forest for habitat resororation. Table 9p.86 | Reducing habitat fragementation and diversified species resembles Cat.A, no 1 Biodiversity. The text does not clarify if reforestation includes cultivated or natural forests. | Grey infrastructure | Not applicable? | |
| | | | | Green infrastructure | Species diversity: Un-even mixed species forests are more resistant to storms and pests and have lower fire risk | |
| | | | | | Regulation for forestry production (if forestry contains forest production activities), taxes on wood products, funds for reconstruction activites | |
| | | | | Soft non-structural appr. | | |
| 6 | Fisheries and Aquaculture | Productivity aspects, efficiency in production by more energy effective fishing gear and methods, removing over capacity, to allow the recovery [of fish stock?] up to an adequate level of resilliance. Fish new species. Table 10p.91 | Clearly relates to fishery and aquaculture as economic activities and does not cover biodiversity issues. | Grey infrastructure | Energy savings by improving vessel and gear design and operation | The WPA includes energy savings as an adaptation measure and grey infrastr. Hard to tell if it relates to adapting to a changed energy supply? Energy saving measures can also be considered mitigating. |
| | | | | Green infrastructure | Ensuring stock levels?? | |
| | | | | Soft non-structural appr. | Subsidies for changing production practises, reg., info and networking | |
| 7 | Energy | Supply and demand. Measures to deal with demand changes, adpating nuclear plants maintenence, invest and install extreme peak load facilitites or alternatives, policies to ensure sustainble generation and distribution, location of energy supply, energy grid management. Table 11p.95 | The description only relates to the energy producers (the supply side) and does not mention the demand side at all. | Grey infrastructure | Physical interventions or construction measures using engineering services to make buildings and infrastructure more capable of withstanding extreme events. | |
| | | | | Green infrastructure | Not applicable? | |
| | | | | Soft non-structural appr. | Taxes on energy, subsidising renewable energy production, regulation in the energy area, information, networking | |

Purple text= SCB interpretation and examples, Black text=from page 29-30 of WPA

| No | Category A | Description | Comments related to typ. Issues catA | Category B | Description (from page 29) | Comments related to typ. Issues cat.B |
|---|---|---|---|---|---|---|
| 8 | Infrastructures and Buildings | Public infrastructure (road, water ways, bridges etc), coast defences, both hard and soft, vulnerability of transport networks to climate events. Planning and building codes, materials, techniques, urban planning, land use planning, relocation acitivities. Table 12p.100 | Includes a mixture of activities and actors. Both public administration such as ministries, agencies for infrastructure issues are included as are researchers and building contractors for housing. | Grey infrastructure | Physical interventions or construction measures using engineering services to make buildings and infrastructure more capable of withstanding extreme events. | Is it possible that the green infrastructure is included here because of reducing the use of air condition equipment for example in new buildings? |
| | | | | Green infrastructure | Green spaces for passive shading, p.100 | |
| | | | | Soft non-structural appr. | Taxes, subsidies legislation to finance and enhance the climate resilience of infrastructure (e.g. road taxes, subsidies for new building materials and production processes), gathering and sharing information, supporting institutional frameworks, supportive social structures | |
| 9 | Industry and Services | Tourism and industry; ski-resorts adaptive measures, industry production, investments and location issues, increse efficiency in the use of raw materials, water and energy in the production process. Table 13p.103 | Includes both economic actors in tourism and industry, but also detailed and specific measures, including energy efficiency. Efficiency issues could also be seen as mitigating activites. | Grey infrastructure | Physical interventions or construction measures using engineering services to make buildings and infrastructure more capable of withstanding extreme events. | |
| | | | | Green infrastructure | Preserving biodiversity and ecosystems through the economic activity (e.g. "green tourism") | |
| | | | | Soft non-structural appr. | Regulating, taxation or subsidising the change in production patterns, information, networks | |
| 10 | Health | Air quality controls, food safety, acclimatisation, heat related mortality, greening of urban areas, green roofs, location issues of public health. Table 14p.108 | This sector covers health related issues where also greening of urban areas are attributed. | Grey infrastructure | Physical interventions or construction measures using engineering services to make buildings and infrastructure more capable of withstanding extreme events. (Eg. air condition equipment, logistics of food security) | The green infrastructure coincides with the green infrastructure of Infrastructure and Building category. |
| | | | | Green infrastructure | Green corridors to provide shade | |
| | | | | Soft non-structural appr. | Regulating or providing guidance on health issues and food safety, information gathering, supportive institutional or social frameworks | |
| 11 | Coastal areas | Includes parts of measures described above: tourism, industry, water availability, water quality, biodiversity-ecosystems, protection against flooding etc. P.109-113 | This is a cross-sectoral group and includes above mentioned measures but for coastal areas only. Should not be compared at the same time as above unless one wants the share of coastal areas measures in relation to total measures. | Grey infrastructure | Flood control works, dams, dikes and levees | |
| | | | | Green infrastructure | Green corridors to provide shade, preserving biodiversity and ecosystems, wetland management | |
| | | | | Soft non-structural appr. | Regulating locality for tourism, industry in sensitive areas, information gathering, supportive institutional or social frameworks | |

Purple text= SCB interpretation and examples, Black text=from page 29-30 of WPA

## Annex 2: Classification of Functions of Government

A full description of the COFOG is available at Eurostat's web-site:

http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-RA-07-022/EN/KS-RA-07-022-EN.PDF

The Classification of the Functions of Government (COFOG) was developed by the Organization for Economic Cooperation and Development and published by the United Nations Statistical Division. It can be applied to government expense and the net acquisition of non-financial assets. COFOG has three levels of detail: Divisions, Groups, and Classes. The Divisions could be seen as the broad objectives of government, while the Groups and Classes detail the means by which these broad objectives are achieved.

01 - **General public services**

01.1 - Executive and legislative organs, financial and fiscal affairs, external affairs

01.2 - Foreign economic aid

01.3 - General services

01.4 - Basic research

01.5 - R&D General public services

01.6 - General public services n.e.c.

01.7 - Public debt transactions

01.8 - Transfers of a general character between different levels of government

02 - **Defence**

02.1 - Military defence

02.2 - Civil defence

02.3 - Foreign military aid

02.4 - R&D Defence

02.5 - Defence n.e.c.

03 - **Public order and safety**

03.1 - Police services

03.2 - Fire-protection services

03.3 - Law courts

03.4 - Prisons

03.5 - R&D Public order and safety

03.6 - Public order and safety n.e.c.

04 - **Economic affairs**

04.1 - General economic, commercial and labour affairs

04.2 - Agriculture, forestry, fishing and hunting

04.3 - Fuel and energy
04.4 - Mining, manufacturing and construction
04.5 - Transport
04.6 - Communication
04.7 - Other industries
04.8 - R&D Economic affairs
04.9 - Economic affairs n.e.c.
05 - **Environmental protection**
05.1 - Waste management
05.2 - Waste water management
05.3 - Pollution abatement
05.4 - Protection of biodiversity and landscape
05.5 - R&D Environmental protection
05.6 - Environmental protection n.e.c.
06 - **Housing and community amenities**
06.1 - Housing development
06.2 - Community development
06.3 - Water supply
06.4 - Street lighting
06.5 - R&D Housing and community amenities
06.6 - Housing and community amenities n.e.c.
07 - **Health**
07.1 - Medical products, appliances and equipment
07.2 - Outpatient services
07.3 - Hospital services
07.4 - Public health services
07.5 - R&D Health
07.6 - Health n.e.c.
08 - **Recreation, culture and religion**
08.1 - Recreational and sporting services
08.2 - Cultural services
08.3 - Broadcasting and publishing services
08.4 - Religious and other community services
08.5 - R&D Recreation, culture and religion
08.6 - Recreation, culture and religion n.e.c.

09 - **Education**

09.1 - Pre-primary and primary education

09.2 - Secondary education

09.3 - Post-secondary non-tertiary education

09.4 - Tertiary education

09.5 - Education not definable by level

09.6 - Subsidiary services to education

09.7 - R&D Education

09.8 - Education n.e.c.

10 - **Social protection**

10.1 - Sickness and disability

10.2 - Old age

10.3 - Survivors

10.4 - Family and children

10.5 - Unemployment

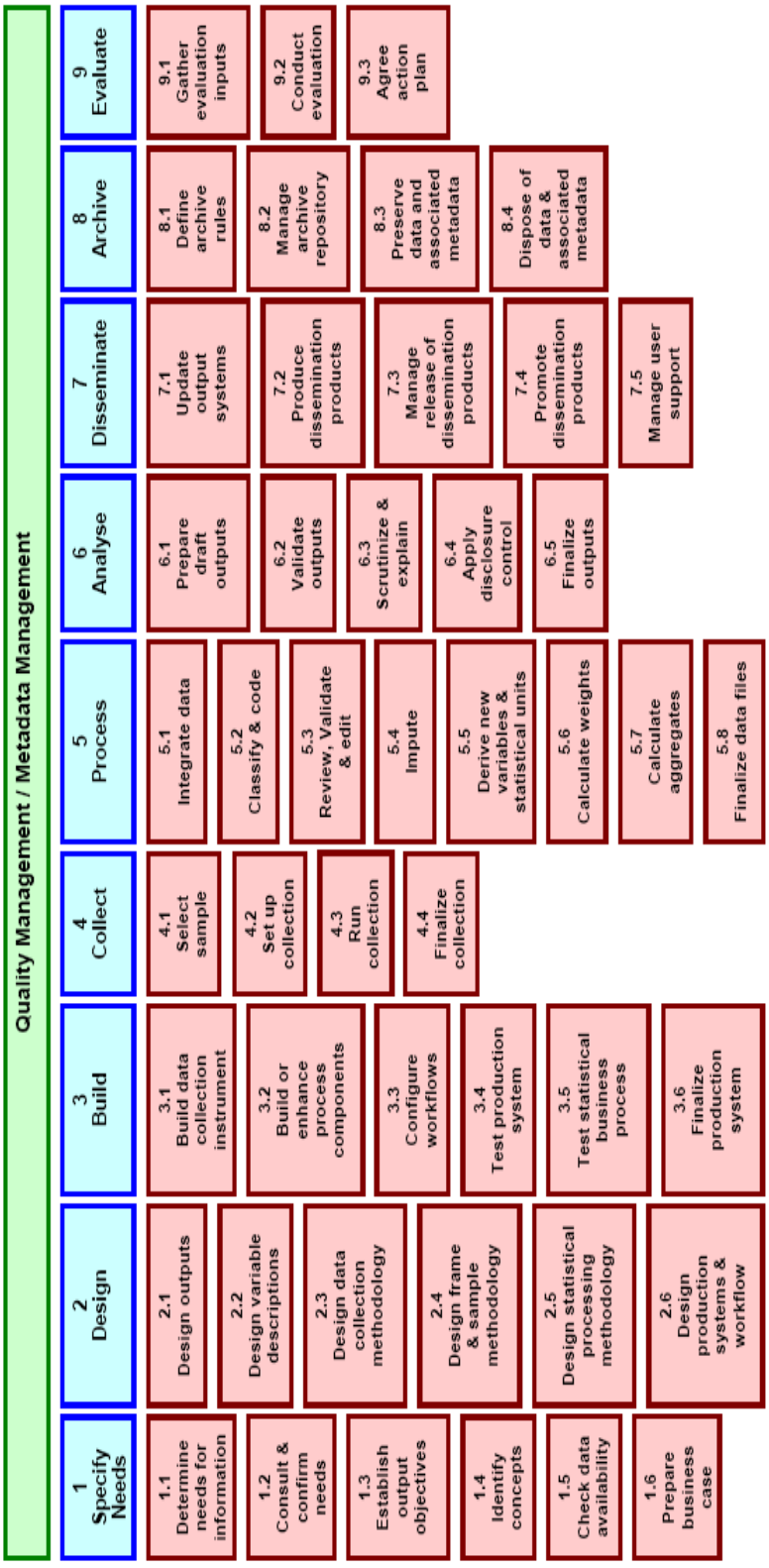
10.6 - Housing

10.7 - Social exclusion n.e.c.

10.8 - R&D Social protection

10.9 - Social protection n.e.c.

## Annex 3: Levels 1 and 2 of the Generic Statistical Business Process Model




Source: Joint UNECE/Eurostat/OECD Work Session on Statistical Metadata (METIS)

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