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Benefit Assessment Manual for Policy Makers: Assessment of Social and Economic Benefits of Enhanced Environmental Protection in the ENPI countries

A guiding document for the project 'Analysis for European Neighbourhood Policy (ENP) Countries and the Russian Federation on social and economic benefits of enhanced environmental protection'

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EXECUTIVE SUMMARY

Europe's neighbourhood is an area of change. In the past decades many of the countries at the border of the European Union (EU) have experienced significant political changes, economic growth and social development. Their relation with the EU has gradually strengthened and was consolidated in 2004 with the **European Neighbourhood Policy (ENP)** and the Strategic Partnership with Russian Federation, which aimed to improve the prosperity, stability and security of the EU and its neighbours. Since 2007 the ENP and Strategic Partnership have been financed through a single instrument - the **European Neighbourhood and Partnership Instrument (ENPI)** - which to date covers 16 countries[1].

Economic and social development has often been accompanied by an **increasing awareness of the importance of natural resources and the environment** in the ENPI countries, and the need to improve their protection and regulation. Improving environmental standards and legislation, however, typically comes at a cost, both in terms of financial investments and/or additional administrative burden, and this can hamper the realisation of much needed environmental-related initiatives, from the improvement of water and waste water and waste infrastructure, to the effective management of protected areas and forests or investments in climate change mitigation and adaptation. Despite their costs, such measures can lead to substantial **benefits in the short, medium and long term**, and avoid larger future costs or even irreversible losses should the current pattern of pollution and resource depletion remain unchanged.

It is therefore important to make the benefit of environmental improvements explicit, in order to appropriately inform policy makers and the wider population about the importance of and opportunities related to wise environmental investments and legislation. In this regard, **Environmental Benefit Assessments** can be a helpful analytical tool, as they allow the examination of the positive outcomes for society that might result from the adoption of environmental protection targets and the implementation of environmental actions to meet these targets. By appraising and, where possible, estimating the economic value of such benefits, these assessment can raise the importance of environmental protection in the political agenda and contribute to 'levelling the playing field' within environmental policy, especially where there is a currently a clearer perception of and focus on costs rather than benefits. They can also offer evidence to policy makers and stakeholders to support arguments for environmental investments and policy integration, by demonstrating the benefits of enhanced environmental protection.

This **Manual for Policy Makers** is meant to provide a pragmatic methodology and step by step guidance on how to carry out an environmental benefits assessment. It is based on the manual specifically developed as a guiding tool for the project's 'Analysis for European Neighbourhood Policy (ENP) Countries and the Russian Federation on social and economic benefits of enhanced environmental protection', commissioned by the European

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[1] on the ENPI see http://www.enpi-info.eu/main.php?id=402&id_type=2

Commission's EuropeAid, which led to the development of national-level benefit assessments for each of the ENPI country[2]. This manual has been tailored here for the more general needs of policy makers and experts intending to carry out their own benefits assessment or update the existing ones. It is primarily targeted at the ENPI countries, but can also be applied to other countries.

The Manual focuses on **five broad environmental themes: Air, Water, Waste, Nature and** the cross-cutting theme of **Climate Change**. To standardise the assessments, the five themes were further divided into sub-themes and 'parameters'. A methodology for the assessment of each single parameter is provided, identifying the data needs, the type of benefits to be investigated (**health, economic and social benefits**) and the extent of the analysis (**qualitative, quantitative or monetary**). An overview of the themes, sub-themes and parameters covered by the Manual is shown in the table below.

Table 1 Overview of themes, sub-themes and parameters

THEME	SUB-THEME	PARAMETER TO BE MEASURED
AIR	Air quality	1) Ambient air quality
WATER	Water - infrastructure and practice	2) Connection to safe drinking water
		3) Connection to sewage network and hygiene conditions
		4) Level of waste water treatment
	Water - natural resources	5) Surface water quality
		6) Water resource scarcity
WASTE	Waste collection	7) Waste collection coverage
	Waste treatment	8) Waste treatment
		9) Methane emissions from waste
NATURE	Biodiversity	10) Level of biodiversity protection
	Sustainable use of natural resources	11) Deforestation
		12) Level of cropland degradation
		13) Level of rangeland degradation
CLIMATE CHANGE	Climate change drivers	Deforestation *(covered under nature)*
		Methane emission from waste *(covered under waste)*
	Climate change	14) Uptake of renewable energy sources

2 The 16 Country Reports and 2 overall Regional Reports are available on the project website: http://www.environment-benefits.eu/

THEME	SUB-THEME	PARAMETER TO BE MEASURED
	responses	15) Climate change adaptation (responses to 2-3 impacts among: sea level rise; sea temperature rise; desertification; water resource scarcity *(covered under water)*;increased risk of pest or disease outbreaks; risk of forest fire; risk of flood; other effects)

Given the large number of countries that were assessed under this project, a pragmatic approach was followed in the manual by focusing only on selected big issues, choosing a mix of environmental problems that were common across the regions, as well as country specific ones. The selection of the parameters was therefore guided by the need to identify issues of general importance which were sufficiently representative of the five environmental areas and simple enough to be assessed within the project. **Other issues, beyond those included here, are clearly also important for some countrie**s. Environmental related topics such as chemicals, nuclear waste, energy efficiency, desertification, mineral/fossil resources, marine fish stocks, and other country specific issues that could not be covered in this work could usefully be taken into account in future country benefit assessments.

Furthermore, it should be taken into account that the methodology outlined in this Manual is but one of the possible pragmatic approaches to translate benefits into actual values. **Other methods are also possible**, and more sophisticated and accurate approaches may also be more feasible in the future, when better data and analytical tools become available, or when resources to explore issues in more depth become available. Note also that there are naturally some methodological limitations as to what can be assessed (e.g. at monetary level) given that many benefits are site specific[3]. The resulting benefit assessment, using the tools here, should therefore be seen as a useful '**order of magnitude**', whose main aim is to communicate the scale and significance of the potential benefits of tackling key environmental issues, while the exact numbers produced by the analysis can be further modified and improved depending on the methodology and data used.

This Manual should be seen as a flexible framework that can be tailored to different geographic and temporal frameworks, data availability and methodological tools. The authors hope it can encourage the wider development and use of benefits assessments and help highlight the benefits of protecting the natural environment through sound environmental policy and integration.

3 For example natural capital's benefits for water purification, water provision and flood control are very site specific. Benefits transfer assessments need to be done with care and with sufficient data.

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ACRONYMS

AQ...................... Air quality
BA .... Benefit Assessment
BAM.................... Benefit Assessment Manual
BAP .... Biodiversity Action Plan
BAT .... Best Available Technique
BAU.................... Business-As-Usual scenario
BCM .... Billions of Cubic Meters per annum
BFT..................... Benefit Function Transfer
C&D .... Construction and demolition
CBD.................... Convention of Biological Diversity
CE....................... Choice Experiment
CH_4..................... Methane
CO .... Carbon monoxide
CO_2 eq. .... CO_2 equivalent
CO_2..................... Carbon Dioxide
COED.................. Cost of environmental degradation
COI..................... Cost of Illness
CV .... Contingent Valuation
DALYs................. Disability Adjusted Life Years
DC .... Dichotomous Choice
DCCV.................. Dichotomous Choice Contingent Valuation
DRF .... Dose Response Function
EC....................... European Commission
E. coli .... Escherichia Coli
EEA .... European Environmental Agency
EIA .... Environmental Impact Assessment
ENP .... European Neighbourhood Policy
ENPI .... European Neighbourhood and Partnership Instrument
EPA .... US Environmental Protection Agency
EU .... European Union
FAO.................... United Nations Food and Agricultural Organisation
GAR.................... Ground Water Recharge
GDP.................... Gross Domestic Product
GEF .... Global Environment Facility
GES .... Good Ecological Status (of surface waters in WFD)
GHG .... Greenhouse gases
GLASOD .... Global Assessment of Soil Degradation
GP .... Gothenburg Protocol
GW..................... Ground Water
HCA.................... Human Capital Approach
HCV.................... Human Capital Value
Hg .... Mercury
IBA .... Important Bird Areas
IPA .... Impact Pathway Approach
IPCC .... Intergovernmental Panel on Climate Change

IUCN .... International Union for Conservation of Nature
JMP .... Joint Monitoring Program
LCU .... Local Currency Unit
MDG .... Millennium Development Goals
MEA........................Multilateral Environmental Agreement
MICS .... United Nations Multiple Indicator Cluster Survey
MSA .... Mean Species Abundance
MSW .... Municipal Solid Waste
NGO .... Non-Governmental Organisation
NH_3 .... Ammonia
NMVOCs .... Non-Methane Volatile Organic Compounds
NO_X .... Nitrogen Oxides
NPV .... Net Present Value
O_3 .... Ozone
OECD .... Organisation for Economic Cooperation and Development
OPT .... occupied Palestinian territory
PA .... Protected Area
PAH .... Polycyclic aromatic hydrocarbons
Pb .... Lead
PC .... Payment Card
PCCV .... Payment Card Contingent Valuation
PE .... Population Equivalent
PM .... Particulate Matter
PPP .... Purchasing Power Parity
RES .... Renewable Energy Source
S .... Sulphur
SEA .... Strategic Environmental Assessment
SEBI .... Streamlining European Biodiversity Indicators
SO_2 .... Sulphur Dioxide
SO_X .... Sulphur Oxides
SW .... Surface Water
SWAR .... Surface Water Runoff
SWQS .... Surface Water Quality Standards
TARWR .... Total Actual Renewable Water Resource
TEEB.......................The Economics of Ecosystems and Biodiversity
TPES .... Total Primary Energy Supply
UN .... United Nations
USD .... United States Dollar
VOCs .... Volatile Organic Compounds
VOLY .... Value of Life Years
VPF .... Value of prevented Fatality
VSL .... Value of Statistical Life
WASH .... Water Supply Sanitation and Hygiene
WDPA .... World Database of Protected Areas
WEI .... Water Exploitation Index
WFD .... European Water Framework Directive
WHO .... World Health Organisation

WTP .... Willingness to Pay
WWT................... Waste Water Treatment

Benefit Assessment Manual for Policy Makers: Assessment of Social and Economic Benefits of Enhanced Environmental Protection in the ENPI countries

1 INTRODUCTION

1.1 This Benefit Assessment Manual

This Manual for Policy Makers[4] on the assessment of benefits of enhanced environmental protection has been prepared within the project 'Analysis for European Neighbourhood Policy (ENP) Countries and the Russian Federation on social and economic benefits of enhanced environmental protection', commissioned by the European Commission's EuropeAid[5]. This benefits assessment manual (BAM) was developed by the Institute for European Environmental Policy (IEEP), together with ARCADIS Belgium N.V., Ecologic Institute, Environmental Resources Management Ltd (ERM), Metroeconomica Ltd and several independent experts.

This Manual builds on the work undertaken for the preparation of country benefit assessment reports for the European Neighbourhood Policy (ENP) countries and the Russian Federation, i.e. the countries covered by the European Neighbourhood and Partnership Instrument (ENPI) funding instrument[6]. This document is based on the Manual specifically developed as a guiding tool for the project's country assessments, but has been tailored for the more general needs of policy makers and experts intending to carry out their own benefits assessments, or update the existing ones. It is primarily targeted at the ENPI countries, but can also be applied to other countries.

It should be noted that the Manual was developed in 2010-2011, therefore if the methodology were to be applied in future assessments, some of its assumptions and approaches may need to be updated to future circumstances (such as different timeframes, updated projections, new available data on carbon values and so on).

Therefore, this Manual can be seen as a flexible framework that can be tailored to different geographic and temporal frameworks. The authors hope it can encourage the wider development and use of benefits assessments and help to highlight the

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[4] Throughout this Manual, the term 'Policy Makers' is used in a broad sense, including also planners in Government ministries and agencies, environment economists and other interested specialists.

[5] European Commission, Directorate-General EuropeAid, Unit F3, Regional Programmes for Neighbourhood East, in coordination with DG Environment, the former DG RELEX, the Europan External Action Service (EEAS) and the EU Delegations in the neighbourhood region and Russia.

[6] The Russian Federation is not formally part of the European Neighbourhood Policy, but holds a 'Strategic Partnership' with the EU. The ENPI financial mechanism provides assistance to both the ENP countries and the Russian Federation. The term 'ENPI countries' is used in this Manual to include both the ENP countries and the Russian Federation.

benefits of protecting the natural environment through sound environmental policy and the integration of environmental perspectives into broader national and local policies.

1.2 The project

The project 'Analysis for European Neighbourhood Policy (ENP) Countries and the Russian Federation on social and economic benefits of enhanced environmental protection', aimed to provide an assessment of the social and economic benefits of enhanced environmental protection for 15 out of the 16 ENP countries[7] and the Russian Federation. Its objectives were to improve awareness of the benefits of enhanced environmental protections within the countries under study and to increase their capacity to assess these benefits. The work therefore intends to encourage the integration of environmental considerations into policy making and the mobilisation of financial resources for environmental improvements.

The countries analysed were: Algeria, Egypt, Israel, Jordan, Lebanon, Morocco, occupied Palestinian territory (OPT), Syria and Tunisia (here referred to as 'ENPI South') and Armenia, Azerbaijan, Belarus, Georgia, Moldova, Russian Federation and Ukraine (here 'ENPI East') (see figure 1.1 below).

A brief overview of the European Neighbourhood Policy is provided in box 1.1.

Figure 1.1 ENP Countries and strategic partner (Russian Federation)

Source: European Commission *http://ec.europa.eu/world/enp/partners/index_en.htm*

[7] Work for this study had started also for Lybia, but had to be stopped due to the political situation.

Box 1.1 The European Neighbourhood Policy (ENP)

The European Neighbourhood Policy (ENP) was initiated in 2004, with the objective of strengthening the prosperity, stability and security of the EU and its neighbours. It consists of bilateral policies between the EU and 16 partner countries: Algeria, Armenia, Azerbaijan, Belarus, Egypt, Georgia, Israel, Jordan, Lebanon, Libya, Moldova, Morocco, occupied Palestinian territory, Syria, Tunisia and Ukraine. A strategic agreement was also signed with Russia – the Strategic Partnership with the Russian Federation.

From 1 January 2007 the European Neighbourhood Policy and Strategic Partnership with the Russian Federation have been financed through a single instrument - the European Neighbourhood and Partnership Instrument (ENPI), which was designed to target sustainable development and approximation to EU policies and standards.

In May 2008 a renewed ENP policy was proposed, accompanied by two joint Communications: 'A partnership for democracy and shared prosperity with the Southern Mediterranean' and 'A new response to a changing Neighbourhood' (EC, 2011a,b). The aim was to strengthen individual and regional relationships between the EU and the ENP countries by making additional funds available in exchange for more mutual accountability.

1.3 The aim of environmental Benefit Assessments (BA)

For the purpose of this project, an environmental benefit assessment is meant to examine the potential positive outcomes for society that result from the adoption of environmental protection targets and the implementation of environmental actions to meet these targets. Such actions may include environmental and other sectoral policies, legislation and investments undertaken by government, industry or other stakeholders, which lead to environmental improvements (e.g. improved water quality from the construction of water treatment plans, reduced air emissions from better regulated industry and transport and so on).

Similar environmental benefits assessments have been undertaken in the past and played an important role in raising awareness of environmental problems, identifying possible solutions, highlighting the benefits of action and stimulating policy attention, focus and action. For instance, they have been carried out in the context of EU enlargement[8], for cities and infrastructure investments[9] and for biodiversity[10].

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[8] ECOTEC, EFTEC, IEEP, Metroeconomica, TME and Candidate Country Experts (2001) *The Benefits of Compliance with the Environmental Acquis for the Candidate Countries*;

Ecolas and IEEP (2005) *The benefits for Croatia of Compliance with the Environmental Acquis*;

Arcadis-Ecolas, IEEP, Metroeconomica, Enviro-L (2007) *Benefits for fYRoM and Other SEE Countriesof Compliance with the Environmental Acquis*

The key aims of a BA are to:

- Appraise and communicate the benefits to human health and well-being of reducing pollution, improving environmental quality, giving greater access to environmental infrastructure and of maintaining and/or investing in natural capital stock;
- Where possible and appropriate, estimate the economic value of such benefits – hence making them comparable and understandable to a wide audience and providing an improved evidence base;
- Contribute to 'levelling the playing field' within environmental policy, as there is often a clearer perception of, and focus on, costs rather than benefits;
- Offer evidence to Ministries responsible for the environment and other relevant Ministries that can support their arguments for funding or policy integration by demonstrating the benefits of enhanced environmental protection.

The Benefit Assessment (BA) methodology here described focus on identifying and analysing the potential benefits arising from the adoption of specific environmental protection targets identified for five thematic areas: Air, Water, Waste, Nature and Climate Change. Given the large number of countries that were assessed under the project, a pragmatic approach was followed by focusing on selected big issues, choosing a mix of environmental problems that are common across the regions (*see examples in Box 1.1)* as well as country specific ones. Notably, the BA aims to provide 'order of magnitude' results, in order to communicate the scale and significance of the potential benefits of tackling these key issues.

Box 1.2 Examples of key issues explored for each of the five themes: Air, Water, Waste, Nature and Climate Change

AIR: How may society benefit from additional improvements in ambient air quality, especially in terms of health?

WATER: i) *Household water supply, treatment, sanitation and hygiene* – What are the benefits of extending access to safe drinking water, improved hygiene and sewage connection? How does society benefit from additional waste water treatment?
ii) *Management of natural water resources* – What benefits accrue from enhancing the quality of bathing and river waters, and to whom?

WASTE - What are the potential benefits to society of reducing waste and improving waste collection and treatment facilities?

NATURE - What are the benefits to society of enhancing biodiversity and the sustainable use of natural resources?

CLIMATE CHANGE-What are the risks related to global warming ? What actions can contribute to the solution?

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9 See e.g., GHK, IEEP, Ecolas, Cambridge Econometric (2006): *Strategic Evaluation on Environment & Risk Prevention under Structural & Cohesion Funds for 2007-2013* - A report for DG Regio

10 *The Economics of Ecosystems and Biodiversity (TEEB)* see www.teebweb.org

Note that other issues, beyond those included here, are clearly also important for some countries. Environmental related topics such as chemicals, nuclear waste, energy efficiency, desertification, mineral/fossil resources, marine fish stocks, and other country specific issues that could not be covered in this work could usefully be taken into account in future country benefit assessments.

1.4 The aim of the Benefit Assessment Manual (BAM)

This Benefit Assessment Manual (BAM) for Policy Makers (hereafter 'the Manual' or BAM) describes the approach used in the project to carry out the country benefit assessments. Whenever possible, the methodology has been simplified and clarified to allow policy makers/experts in ENP and other countries to replicate this exercise and carry out their own assessments.

This work builds on previous analyses and methodologies, in particular on IEEP's Methodology for ENP countries (ten Brink and Bassi, 2007) and the World Bank's Cost of Environmental Degradation (COED) reports (Bolt et al., 2005). The resulting methodology is tailored to reflect the needs and priorities of this project and takes into account recent relevant data and studies.

The Manual provides an introduction and step by step guidance on the approach to follow to carry out a BA. It sets out the main environmental themes, sub-themes and parameters to be analysed, identifies the type of data needed for the assessment, clarifies which environmental, health, economic and social benefits should be investigated and the extent of the analysis (qualitative, quantitative or monetary). A summary of what has been covered in this manual (and in therefore in the project) can be found in chapter 2.5.

As noted above, besides explaining the approach used under this project, the BAM can be used to carry out future assessments, including to update ENP country BAs once data become more readily available and additional resources found to carry out focused analyses of smaller areas where data are more abundant (e.g. to help with city or coastal planning), to develop sensitivity analysis (e.g. taking into account different national targets or different baselines to explore country specific objectives for specific issues), or to develop new BAs in countries outside the ENPI coverage.

This BAM for Policy Makers is meant to be used by organisations such as ministries of environment and climate change, public works and water, health, or economics and finance as well as municipal and other national/regional/local authorities and stakeholders that have an interest in BAs (see Table 1.1 for a list of potential users).

Table 1.1 Organisations that can make potential use of Benefit Assessments

Organisation	Potential use of Benefit Assessments (BAs)
National ministries of environment	BAs provide additional arguments to help secure funding for environmental policy implementation and help to promote policies and set targets for improving the environment.
National ministries of finance, economy, trade and planning	BAs help the executive make the case for environmental protection and conservation investments that may lead to additional economic benefits for example, increases in tourism leading to job creation etc. Moreover, improvements in health conditions reduce costs for national health systems.
National ministries of health, labour, social affairs, and consumer protection	Avoided health impacts reduce the need for treatment and days of lost employment thereby reducing costs borne by the economy, losses in productivity or additional costs incurred by public or private health systems. Jobs supported in rural areas to help with rural viability and livelihoods.
Other ministries (e.g., water, energy, agriculture, tourism, etc.) or national public bodies	BAs can provide additional arguments for undertaking necessary reforms, and/or adjusting tariffs / charges in their respective sectors (e.g. water pricing), and spatial planning (e.g. zoning for tourism safeguard biodiversity while encouraging tourism)
Parliament	BAs can help legislators responsible for environmental matters to make the case for better environmental protection and conservation legislations.
Judiciary (ministry of justice)	The Judiciary can use BAs as part of the evidence base for court cases (polluter liability etc).
Regional and local authorities	BAs can provide additional arguments to these authorities when looking to build on natural capital – for example using landscape and nature as a flagship to attract tourists – or building on natural capital/ecosystem services to reduce risks from natural hazards (flooding, fires and drought).
Local authorities/Municipalities	BAs clarify the benefits of addressing urban transport, enforcing emissions legislation/standards (e.g. for air, water, waste) and investing in environmental and cultural infrastructure.
Environmental inspectorates/enforcement agencies (at national or regional level)	BAs provide arguments for ensuring that resources are available to enforce legislation; without enforcement many benefits would not be realised.
Private sector and banking	BAs can facilitate dialogue between the authorities and polluters or present opportunities for private sector involvement (public-private partnerships, green economy etc) and bank financing.
Communities	BAs can help demonstrate the value of community resources and importance of community management of community resources – e.g. forestry, fisheries.
Civil society (NGOs, CBOs, particularly the poor), professional associations and networks, unions, media, academia, blogosphere, etc.	BAs enhance awareness of the benefits of environmental improvement and provide information that can support NGOs and other stakeholders lobbying for enhanced environmental protection. In this way standards of living can be raised due to improved environmental quality and greater access to clean resources such as water.
The Development Partner community	The Development Partner community could engage the government on the basis of the BAs to set intervention priorities

1.5 Structure of the Benefit Assessment Manual

This report is structured as follows:

- **Chapter 2** provides an **overview of the methodology** for Benefit Assessments, identifying the type of benefits and the environmental categories covered by this BAM, providing an overview of the key expected benefits and clarifying issues about the depth of the analysis;
- **Chapter 3** describes the **methodological steps** to be undertaken to carry out a benefit assessment;
- **Chapter 4** provides information on **practical issues** for the assessment, including data gathering, monetary assessment and the presentation of results and sensitivities;
- **Chapter 5** presents the detailed methodology for the parameters under the theme '**Air**';
- **Chapter 6** presents the detailed methodology for the parameters under the theme '**Water**';
- **Chapter 7** presents the detailed methodology for the parameters under the theme '**Waste**';
- **Chapter 8** presents the detailed methodology for the parameters under the theme '**Nature**';
- **Chapter 9** presents the detailed methodology for the parameters under the theme '**Climate Change'**
- **Chapter 10** presents some key **conclusions** and suggestion for future benefits assessment approaches

More detailed information is provided in the following annexes:

- Annex I provides a list of useful information sources for conducting a Benefit Assessment
- Annex II offers some insights on the assumptions used for benefit/value transfers across countries
- Annex III presents further details on the methodology for ambient air quality
- Annex IV presents further details on the methodology for assessing the health benefits from reaching drinking water, sanitation and hygiene targets;
- Annex V presents further details on the methodology for surface water quality, and;
- Annex VI includes a checklist for data collection

2 OVERVIEW OF THE METHODOLOGY FOR BENEFIT ASSESSMENTS

This chapter introduces the methodological framework proposed in this BAM for the assessment of the benefits related to environmental improvements. The key concepts related to the benefits assessment are explained below, namely:

- the environmental **themes** (air, water, waste, nature and climate change), **sub-themes** and **parameters** covered by this BAM;
- the type of **benefits** that can be assessed (environmental, health, economic and social), and;
- the **level** of the analysis (qualitative, quantitative, monetary).

2.1 Environmental categories under analysis

The improvement of environmental conditions encompasses a vast range of environmental areas and policies. Clearly not everything can be covered by a BA and therefore a selection of key environmental issues was made under the project. These are five broad categories, referred to as 'themes': Air, Water, Waste, Nature and Climate Change (as a cross-cutting theme).

To standardise the assessments for each country, the five themes were further divided into *sub-themes* and for each sub-theme smaller categories called '*parameters'* are assessed. The parameters are the smallest 'units' of the analysis.

The selection of the parameters was guided by the need to identify issues of importance which were both sufficiently representative of the five environmental areas, and simple enough to be assessed within the project. The rationale for the selection of the parameters is briefly explained in the detailed methodology description by theme in chapters 5-9. Future BAs could expand the range of themes and parameters analysed and include, for example, soil quality or energy efficiency. The list of themes, sub-themes and parameters covered by the project and thus by this BAM is provided in the table below.

Table 2.1 Overview of themes, sub-themes and parameters

THEME	SUB-THEME	PARAMETER TO BE MEASURED
AIR	Air quality	1) Ambient air quality
WATER	Water - infrastructure and practice	2) Connection to safe drinking water
		3) Connection to sewage network and hygiene conditions
		4) Level of waste water treatment
	Water - natural resources	5) Surface water quality
		6) Water resource scarcity
WASTE	Waste collection	7) Waste collection coverage
	Waste treatment	8) Waste treatment
		9) Methane emissions from waste
NATURE	Biodiversity	10) Level of biodiversity protection
	Sustainable use of natural resources	11) Deforestation
		12) Level of cropland degradation
		13) Level of rangeland degradation
CLIMATE CHANGE	Climate change drivers	Deforestation *(covered under nature)*
		Methane emission from waste *(covered under waste)*
	Climate change responses	14) Uptake of renewable energy sources
		15) Climate change adaptation (responses to 2-3 impacts among: sea level rise; sea temperature rise; desertification; water resource scarcity *(covered under water)*;increased risk of pest or disease outbreaks; risk of forest fire; risk of flood; other effects)

2.2 The benefits of an improved environment

The BA undertaken in the project and described in this BAM focuses on four categories of benefits deriving from environmental improvements related to the parameters listed above:

- **Environmental benefits**: the uptake of environmental targets and actions clearly brings a direct benefit to natural assets. It should be noted that 'environmental benefits' are here considered distinct from the 'environmental improvements' the benefits stem from. In this BAM, environmental improvements are considered changes in the parameters related to the achievement of certain targets (e.g. improved waste water treatment from achieving 100 per cent secondary treatment), while environmental benefits are the positive impacts these targets have on the natural environment (e.g. improvements of aquatic ecosystems and avoidance of eutrophication events that can lead to biodiversity loss).

- **Health benefits**: these are often interpreted as social benefits but given their strategic importance and magnitude, they are assessed as a separate category. Direct benefits to public health include for example; a reduction in the cases of illness and the avoidance of premature mortality arising from water-borne diseases, a reduction in respiratory and cardio-pulmonary diseases associated with poor air quality etc.

- **Economic benefits**: these include economic benefits from natural resources (e.g. tourism benefits relating to protected areas, landscape, beaches, coral reefs etc.), eco-efficiency gains (e.g. from recycling, energy capture, from higher fish provision due to healthier ecosystems etc.), avoided costs (e.g. of hospitalisation and lost days at work from health impacts, avoided climate change impacts etc.), the development of new and existing industries/sectors of the economy, balance of payments and trade effects (e.g. reduced imports of primary material as more waste is reused and recycled) and increased employment through environmental investments (e.g. potential from developing the waste collection sector, from growth in eco-tourism etc.).

- **Social benefits:** benefits to the society at large including the safeguarding of, and access to, natural and cultural heritage (e.g. through avoided conversion or pollution damage to landscape and historic building), viability of (rural and coastal) communities and employment/livelihoods (e.g. in forest management, agriculture, fisheries, nature based tourism), recreational opportunities (fishing, bathing etc.), benefits of trust in quality environmental service provision (e.g. water quality) and social cohesion related to employment opportunities, social learning and the development of civil society (due to increased information provision, consultation and involvement).

It is important noting that the assessment of benefits includes elements which are related to the concept of ecosystem services i.e. the benefits that people obtain from natural ecosystems (species, genes, water/air purification, soil regeneration, timber, fuel,..). Some of these services provide tangible goods (e.g. provisioning food or fibre), others provide non-market services such as regulating climate, opportunities for recreation, or supporting local cultural identity. Enhancing environmental protection will increase the capacity of ecosystems to provide such benefits (TEEB 2010, TEEB 2011) and therefore, these should also be taken into account in the analysis when relevant. Ecosystem services are grouped using a slightly different classification than the one used in this study. For clarity, in the box below we provide a brief overview of how ecosystem services are classified and how they relate to the approach used in this BAM.

Box 2.1 The theory of ecosystem services in relation to the benefit assessment method

Ecosystem services are the benefits that people obtain from ecosystems. According to the widely used classification developed by the Millennium Ecosystem Assessment (2005) and taken up in TEEB (TEEB 2010, TEEB 2011), these services can be categorised as follows:

- Provisioning services such as food, fibre, fuel, water and genetic materials.
- Regulating services i.e. benefits obtained from ecosystem processes that regulate our natural environment such as the regulation of climate, floods, disease, waste and water quality.
- Cultural services such as recreation, aesthetic enjoyment, tourism as well as cultural identity.
- Supporting services i.e. services that are necessary for the production of all other ecosystem services such as soil formation, photosynthesis, and nutrient cycling.

Although the BA encompasses more than the benefits from ecosystems, it is useful to clarify how the benefits from ecosystems - the ecosystem services - can be included in the study. The table below show a simplified categorisation of ecosystem services according to the BA's four benefit types.

Table 2.2 Summary overview of benefits associated with the sub-themes

Benefit Assessment	Services Derived from the Millennium Ecosystem Assessment
Environmental benefits	Provisioning services (with no commercial value) – e.g. non-timber forest products, water provision Regulating services (excluding disease regulation) – e.g. climate regulation Supporting services (avoiding double counting with other services)
Health benefits	Regulating services: disease regulation; water and waste regulation
Economic benefits	Provisioning services (with commercial value) e.g. fisheries production; cultural services such as tourism; avoided costs of natural hazard management, avoided costs of water purification.
Social benefits	Cultural services, e.g. recreation; cultural identity

2.3 Overview of benefits for each theme and sub-theme

An overview of the key health, environmental, economic and social benefits related to each sub-theme is provided the table below. A more detailed list of benefits for each of the parameters is provided in chapters 6 to 10.

Table 2.2 Summary overview of Benefits associated with the Sub-themes

BENEFITS	HEALTH	ENVIRONMENT	ECONOMIC	SOCIAL
Air				
Air quality	Avoided cases of respiratory discomfort and diseases (morbidity) and early mortality.	Reduced damage to habitats vulnerable to acid deposition.	Avoided loss of output (e.g., crops), cost of hospitalization, damage to buildings etc.	Improved quality of life from improved air quality, enjoyment of open air activities, improved amenity of urban areas etc.
Water				
Water related Infrastructure and practice	Avoided cases of diarrhoea and other water borne diseases, child under-nutrition, early mortality etc.	Reduced impacts from polluted water resulting from untreated waste water discharge, agricultural run-offs (e.g. fertilisers, pesticides) and other pollutants (e.g. affecting rivers, ground water and coastal areas).	Avoided loss of outputs and reduced hospitalisation costs, reduced expenses for household water treatment and alternatives sources e.g. wells, bottled water ; and avoided loss of outputs (e.g. fisheries and tourism loss from coastal eutrophication) etc.	Increased comfort from improved access to clean water, improved perception of public services, improved amenity of water courses and less social exclusion.
Water: Natural resources (surface water, ground water, bathing water etc.)	Reduced cases of diarrhoea and other water borne diseases, increased water availability for human consumption.	Benefits for habitats and ecosystem services and species conservation (especially fish).	Increased revenues from tourism and recreation (water sports, angling etc.), enhanced agricultural production.	Increased wellbeing from recreation and amenity opportunities and less social exclusion.
Waste				
Waste collection	Reduced risk of respiratory diseases (e.g. from waste burning) and disease spread (e.g. from rats and insects, from foraging on landfills etc.).	Improved landscape and less risk of environmental contamination and GHG emission.	Increased value of local property, increased agriculture output, employment opportunities.	Reduced odour and visual intrusion.

BENEFITS	HEALTH	ENVIRONMENT	ECONOMIC	SOCIAL
Waste treatment	Reduced risk of respiratory diseases (e.g. from burning), risk of accident (from landfills and methane), and disease spread (e.g. from rats and insects), avoided risk of water pollution (leachate).	Improved landscape, reduced damage from leachate and release of hazardous substances to the environment, reduced use of natural resources and reduced GHG emission.	Increased amenity (recreation / tourism opportunities), recovery of materials and employment opportunities, reduced use of primary raw materials.	Reduced odour and visual intrusion, reduced risk of impacts, less social exclusion.
Nature				
Biodiversity	Benefits from improved water and air quality, reduced risk from natural hazards (e.g. flooding and fire), reduced risks of pests (bio-control)..	Enhancement of ecosystem services e.g. carbon storage, flood control, water storage and purification etc., increased resilience to climate change.	Increased revenue from eco-tourism in well managed protected areas and key habitats e.g. coral reefs in Egypt. Avoided loss of agricultural outputs (e.g. from loss of natural pollinators)	Increased amenity and wellbeing from recreation. Benefits to cultural identity, education and scientific knowledge
Sustainable use of natural resources	Help maintain air purification functions (e.g. from reduced deforestation; city green infrastructure) hence reduce respiratory diseases.	Benefits to biodiversity, enhanced carbon storage, water storage and protection of soils (quality and avoided erosion).	Revenue from increased agricultural and forestry production and tourism (e.g. from reduced deforestation and cropland/rangeland degradation).	Enhanced landscape and amenity (e.g. from better management of land, forests).
Ecosystem Services	Assessed under other themes			
Climate Change				
Climate change drivers	Assessed under other themes (e.g., deforestation)			
Responses to climate change	Reduced risks of respiratory diseases due to fossil fuel emissions abatement, reduced disease and early mortality arising from projected impacts of climate change (temperature change, increase in natural hazards, changes in precipitation rates, sea level rise).	Benefits to biodiversity and ecosystem services arising from reduced impacts of climate change (e.g., on coral reefs) and reduced emissions.	Opportunities for industry and innovation (RES, energy efficiency), avoided cost (fuel imports, fuel bills) and loss of output.	Avoided loss of amenities due to climate change, improved access to energy sources (e.g., from RES).

2.4 The level of analysis

The benefits arising from improved environmental conditions can be analysed in three ways: qualitatively, quantitatively and monetarily - depending on the type and amount of information available.

1) In **qualitative terms;** providing a full description of the nature of the benefit, the people, land areas, sectors and services affected and, when relevant, an indication of the spatial distribution of the benefit (for example, as a map showing locations or regions in the country affected, or the neighbourhoods or social groups affected in urban areas).
   This is the easiest approach and is applicable to all parameters.

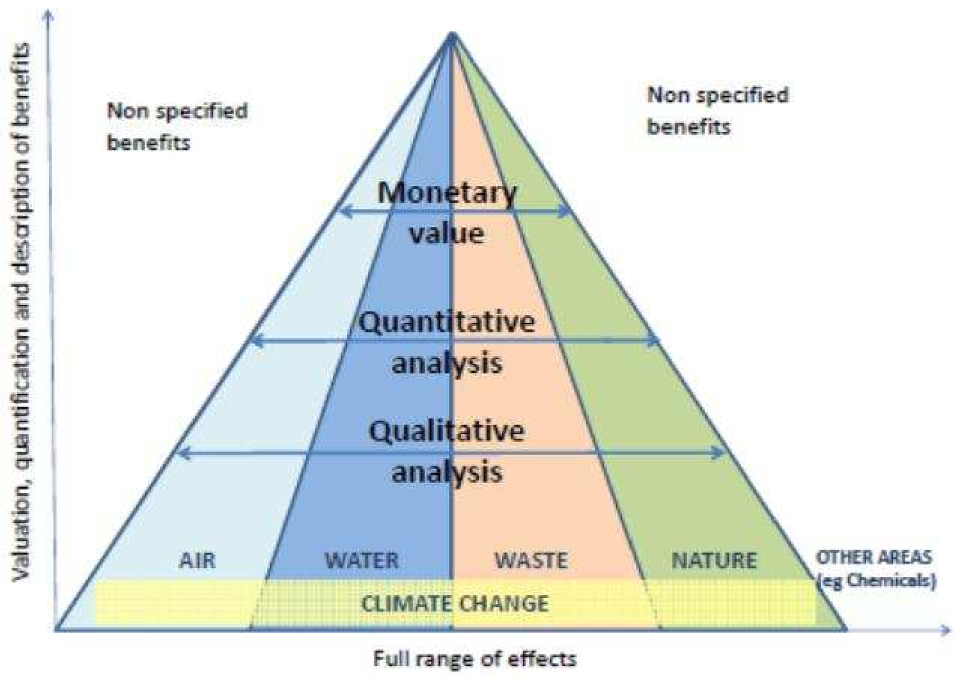
2) In **quantitative terms;** whenever quantitative data are available (e.g. cases of morbidity/mortality avoided etc.), to indicate the actual, relative or proportionate scale of the benefit arising from the environmental improvement identified. For example, the improvement of ambient air quality and/or water quality can lead to a quantifiable reduction in the number of cases of disease and early mortality. The improvement of water quality and protected areas management can lead to increase in the number of fish and in the number of bathers. Improved management and restoration of forests and wider green infrastructure around population centres can lead to the increased provision of cleaner water (quality and quantity). Reduced deforestation can avoid the loss of a certain amount of carbon and afforestation increase carbon sequestration.
   This approach is more data intensive and is applicable to several but not all the parameters, depending on the data available and the possibility to link environmental improvements to actual physical effects.

3) In **monetary terms,** when possible. This approach multiplies the quantitative benefits identified above by a money unit value (or a range of values) to give a monetary value of the benefit to society of a certain environmental improvement. Unit values include the value of a tonne of carbon, hospitalisation costs, value of a tonne of fish etc. The overall value to society can be the amount of money saved if a certain improvement is made (e.g. avoided hospitalisation costs from avoided illness across the population), market values of products or savings (e.g. increased revenues from fisheries locally or nationally, increased total value of carbon stored) or a measure of people's willingness to pay (WTP) for a benefit (e.g. for access to clean drinking water, river or bathing water quality). Such economic values may be obtained from cost data for specific services (e.g. cost of water treatments), market values for commodities (e.g. fish, carbon), survey data documenting WTP responses, modelling studies or benefit transfer studies. A discount rate can be applied to the monetisation of each benefit e.g. if Net Present Values (NPV) are used, but this was not the case in this study. This approach is the most data intensive and is applicable only to a smaller sub-set of parameters. There are also some methodological limitations which make the analysis of certain issues more difficult than of others, at certain scales. For example, assessing the benefits of water purification or flood control

mitigation via natural capital (e.g. local forest or wetland) is possible for a city or town, but doing so for a country as a whole will either be majorly resource intensive (requiring case by case analysis for all major agglomerations), or methodologically questionable if using benefits transfer, as the benefits are so site specific. For carbon storage, on the other hand, a tonne of carbon can be taken as having the same value wherever it is stored, making assessing the value more feasible.

The adoption of this three-level approach is important as the availability of suitable data will typically vary between each parameter and between countries, and methodological tools are easier to apply for some issues than others. The feasibility of undertaking complex quantitative and monetary analysis also depends on the scope of a BA and the resources and expertise available. In general, most benefits are identifiable in qualitative terms, a subset of them in quantitative terms and a smaller set in monetary terms. This leads to a pyramidal assessment (see figure 2.2 below) of the benefits of environmental improvements, whereby detailed values can be given for a small range of benefits while the value of several benefits remain unknown. This may result in many benefits being overlooked as no monetary value can be attached to them. For this reason it is important to ensure that the full range of benefits arising from enhanced environmental protection is portrayed to some extent, and that the BA is not constrained by focusing only on the elements that can be quantified or monetised. A BA should therefore look at all of the three approaches, trying to develop a representative picture of the benefits. In some cases when national data do not allow a detailed analysis, local case examples can be valuable to help communicate issues relating to particular benefits. In any case, eventual future country assessments should also present the spatial perspective – indicating where the benefits occur and also, ideally, providing insights into spatial interconnectivity - e.g., which forest, grassland or wetland offers which services to which town or city; and where action in one area leads to benefits further afield (e.g., marine protected area and restoration helping fishing communities, reduced emissions from urban sewage leading to improvements to certain water bodies and leading to benefits to range of communities). Demonstrating the interaction between actions and beneficiaries can be important to support the implementation of given measures and their associated investment.

Figure 2.1 Benefits pyramid: qualitative, quantitative and monetary assessment



2.5 Overview of the coverage of this methodology

As noted above, not everything can be assessed in qualitative, quantitative and monetary terms. Furthermore, issue of data availability and of resources available for the research may further constrain the extent of the analysis. It is important therefore to follow a pragmatic approach and be realistic as to what can be covered and to what extent. An overview of what could be covered under this methodology (and therefore under the project) is shown in the table below.

Table 2.3 Overview of the coverage of the Manual

#	Parameters	Qualitative	Quantitative	Monetary
1	Ambient air quality	Environmental, Health, Economic, Social	Health, Economic	Health, Economic
2	Connection to safe drinking water	Environmental, Health, Economic, Social	Health (under (3))	Health (under (3))
3	Connection to sewage network and hygiene conditions	Environmental, Health, Economic, Social	Health	Health
4	Level of waste water treatment	Environmental, Health, Economic, Social	Health partially captured under (3)	Health partially captured under (3)
5	Surface water quality	Environmental, Health, Economic, Social	Environmental, Economic, Social	Environmental, Economic, Social
6	Water resource scarcity	Environmental, Health,		

#	Parameters	Qualitative	Quantitative	Monetary
		Economic, Social		
7	Waste collection coverage	Environmental, Health, Economic, Social	Environmental, Economic	Environmental, Health, Economic, Social (under (8))
8	Waste treatment	Environmental, Health, Economic, Social	Environmental, Economic	Environmental, Health, Economic, Social
9	Methane emissions from waste	Environmental, Health, Economic, Social	Environmental	Environmental, Economic
10	Level of biodiversity protection	Environmental, Health, Economic, Social		
11	Deforestation	Environmental, Health, Economic, Social	Environmental	Environmental, Economic
12	Level of cropland degradation	Environmental, Health, Economic, Social	Economic	Economic
13	Level of rangeland degradation	Environmental, Health, Economic, Social	Economic	Economic
14	Climate change mitigation: RES	Environmental, Health, Economic, Social	Economic	Economic
15	Climate change adaptation	Environmental, Health, Economic, Social		

3 METHODOLOGICAL KEY STEPS

To complement the theoretical framework of the assessment, this chapter presents an overview of the key steps necessary to undertake a benefit assessment. These steps are to be applied to the analysis of each parameter under assessment, when data allow. The aim and general approach of each step is herein explained in detail, together with the related assumptions that were made under the project, whilst the actual way these steps apply to each of the parameter is described in detail in chapters 5-9.

3.1 The key methodological steps: overview

The process to carry out a BA can be broken down into 5 main steps. These are:

1) **Define the current state of the environment (reference point):** a description of the current environmental conditions is needed to establish a reference point against which to assess improvement in the environmental parameters. This is a critically important step, both to strengthen the robustness of the assessment and to ensure credibility, as the BA should provide an accurate and reliable description of the country's key issues. For the project the year 2008 was chosen as the reference year. Future BAs could choose other reference years, depending on relevance and data availability. See section 3.2 below for more details on this step.

2) **Define the baseline to 2020:** baseline projections of how the state of the environment is expected to change by 2020 should be made on the basis of projected developments in the underlying economic and demographic factors that affect the environment. The key factors taken into account under the project include Gross Domestic Product (GDP) and population growth. The baseline is meant to be a business as usual scenario (BAU), which assumes no policy development is made by 2020. Baselines are required for a range of parameters because, as the assessment looks at environmental improvements to be achieved by 2020, it is necessary to compare future improvements with future 'no action' scenarios (i.e. if no new policy measures are implemented). The level of definition of the baseline can be pragmatic or sophisticated, depending on the issue, the data and resources available and the models used. Note that it is never possible to predict with any accuracy what will happen into the future, so the objective should be one of setting a baseline scenario that is reasonable, understandable and defensible that helps, when linking to targets, create illustrative and informative results. See section 3.3 below for more details on this step.

3) **Establish the targets:** in order to establish what the 'environmental improvements' could be, theoretical environmental targets need to be set for each of the parameters to enable comparisons. For the purpose of the project, the targets chosen were not explicitly related to actual policies existing in the ENPI countries (as the project did not aim to assess national policies). The

targets selected for the project were derived from targets adopted by the EU or by international organisations such as the World Health Organisation (WHO). The targets selected should be seen as a theoretical indication of what an 'ideal' (yet realistic) environmental target can bring in terms of environmental improvements, to help assess and communicate the level of benefits. Common targets have been set across the countries covered by the project for each of the different parameters; the distance to the target and hence the ease and benefits of meeting the targets therefore vary. Although some countries are likely to be able meet such targets earlier than others, for assessment and comparability purposes a common timeline was chosen: the year 2020, which is near enough to be politically relevant but far enough into the future to allow significant progress with ambitious action. See section 3.4 below for more details. Clearly countries can, in future analysis, do sensitivity analysis that integrates a wider range of target variants than used in the cross-country analysis of this study.

4) **Compare the targets to the baseline or the reference point:** this step requires the identification of the expected environmental improvements that could be achieved if the targets were met, by comparing the proposed target for each of the parameter with the baseline (business as usual scenario in 2020) or, if the baseline could not be assessed, the reference point (in 2008). For some parameters the comparison with the reference point is sufficient (e.g. as regards to river quality, or protected areas covered). Where the baseline is relevant and can be assessed (e.g. for access to quality drinking water where the number of people benefiting will increase not just because of investments but also due to population growth) the target should be compared to this. For sensitivity analyses, comparisons with both the 2008 reference point and the 2020 baseline can be made to obtain additional insights. See section 3.5 below.

5) **Assess the benefits:** this step implies the assessment of the range of benefits (environmental, health, economics and social) that would result from the environmental improvements if the targets were met. This requires the use of a combination of qualitative, quantitative and monetary approaches according to the data available, as noted in chapter 2.4 above. Further details are provided in chapter 3.6. It can be useful to combine a mix of national level insights, which will be 'big picture' results, with local cases that can offer greater depth and sensitivity analysis of issues. Together they can create a more complete picture and interesting narrative.

These five steps are described in more detail in sections 3.2.1 – 3.2.5 below, and have been used to structure the methodology for each parameter, presented in chapter 7-11.

It should be noted that, to carry out the benefit assessment, a number of **assumptions** need to be made for each of the methodological steps. Some of the key assumptions that were made under the project have been summarised in boxes below each step. A more detailed overview of numerical assumptions is discussed in chapter 3.3.3.

3.2 The reference point

The first step in the assessment of the benefits of environmental improvements is to establish the 'reference point'. This is the current state of each parameter, where relevant for the country. The reference level establishes the starting point from which baseline projections are to be made for the year 2020 (see 3.3 below).

An overview of the state of the environment should be provided for the entire country, although in cases where national data are scarce, it can be focused on specific areas or cities.

In determining the reference point for each of the parameters to be measured, the analysis should include an overview of:

- The *state of the parameter* in terms of its extent, distribution / location (as appropriate), quality and current level of protection. For *man-made infrastructure parameters* (such as water supply and waste water treatment), information should be given on the share/number of people affected (e.g. number of households connected to the sewage network), what share of pollution they deal with (e.g. amount of waste water treated) etc. as well as the 'quality' of the infrastructure with respect to environmental protection;

- The nature of *key driving forces* affecting them: economic dynamics, population, consumption patterns etc. Some of these will have to be factored into the baseline (e.g. population growth) while others will remain qualitative observations (e.g. where the data/methodological complications would be too great, or the additional nuancing of the final result too small), and;

- The main *environmental pressures*: pollutants/emissions generated, use of resources, natural hazards etc.

The overview should include both the positive impacts (e.g. economic revenue currently generated by the parameter e.g. drinking water tariffs) and the negative impacts associated with the current state of the parameter (e.g. respiratory diseases from urban air pollution or poor water quality). Benefits (as assessed in the next steps) will be associated with maintaining or increasing the positive aspects as well as reducing the probability / incidence of negative impacts.

In summary, the purpose of this step is to provide a clear understanding of the current state of, and threats to, each parameter. This step will rely substantially on expert opinion / published information gathered through literature reviews and direct contacts with relevant authorities and experts in the country (see chapter 5.1 'Data gathering approach'). It is important to ensure that the information sources from which the data are obtained are well-recognised, reliable and properly referenced. Data gaps should be clearly highlighted.

An indication of the data required for establishing the reference point for each parameter to be measured is provided in each related parameter chapter (see chapters 5-9)**.**

For certain issues it should be possible to obtain data at the national level (e.g. for water supply infrastructure). For other parameters, data may in some cases only be available for areas where the benefits are most significant (e.g. key urban agglomerations affected by air quality changes). In other cases, location specificity can be key to determine the status of the parameter (e.g. protected area and benefits to nearby urban areas). A local case example can be developed to help communicate issues relating to particular benefits.

Assumption: The reference year
This requires a recent year with good data.
The reference year used in the project was 2008, as this was the most recent year for which complete information was available in most of the countries. In general, the choice of the reference year will depend on the data available in each country. Another year (more or less recent) can be used. It will be important to note carefully the year used, in order to ensure transparency and, in case of multi-country analysis, understand how/if data are comparable across them.

3.3 The baseline scenario

The aim of this step is to make baseline projections of how the environmental issues (parameters) may evolve to 2020 if 'no action' is taken (i.e., no new policies launched and implemented). To make the approach as simple as possible, this is meant to be a basic projection of the current environmental conditions to 2020, based on expected trends in underlying economic and social factors (e.g. GDP, population growth etc.). For example, if the population is expected to increase, this will imply an increase in waste generation, and in the number of people exposed to poor air quality etc. An indicative list of possible elements to factor into the baseline estimates is shown in the table below.

In some cases making projections for the business as usual scenario in 2020 may be too difficult. For instance, there may be number of different drivers that will have different (and often opposing) effects on baseline pollution levels (economic development, industrial structure, fuel use, number and use of vehicles, fuel quality, climatic conditions, changes to natural capital, etc.) and it may be too complex to take all of them into account. In case the baseline cannot be assessed, the most pragmatic approach is to assume that the situation in 2020 will be the same as today - i.e. to assume that the baseline is the same as the reference point. This is also shown in the table below. Further guidance on when this may be the case is provided in the parameter sheets (chapters 5-9).
Note that the longer the time frame is, the less robust the baseline estimates will be. For example, while population estimates for 2020 may be relatively uncontroversial, demographic assumptions for 2030 or 2050 are likely less robust (see discussions on the choice of timeline in chapter 3.4).

Table 3.1 Overview of issues to factor into the baseline to 2020

(as integrated in the ENPI analysis; countries embarking on own additional analysis can add other factors where helpful for the objectives of their analysis)

	BAU baseline to 2020 – key variables to factor into baseline in relation to the reference point	***Reason / effect***
1) Ambient air quality	GDP, population (Urban population share if available)	The higher the population, particularly in urban areas, the higher the number of people exposed to (poor) air quality, and higher risk of health incidence. Income levels can affect the WTP for avoided respiratory diseases, value of lost output and VSL (value of statistical life)
2) Connection to safe drinking water	GDP, population	As the population grows, the number of people potentially benefitting will increase; as income rises their willingness to pay to have access to safe drinking water is likely to increase.
3) Level of sanitation and hygiene	GDP, population; same as for drinking water	As with drinking water, the value of benefits will be affected by the number of people benefitting from improved sanitation and hygiene, and their income levels will influence their willingness to pay.
4) Level of waste water treatment	Population	An increase in population can be expected to lead to an increase in the number of people producing waste water and benefitting from increased sewage connection and treatment
5) Surface water quality	GDP, population	Number of people benefiting from improved surface water quality and their willingness to pay
6) Water resource scarcity	Same as reference level (unless climate change effects will significantly reduce renewable fresh water in the future)	Using only the reference level (i.e., not using a baseline) is easier to communicate and calculate.
7) Waste collection coverage	Waste growth rate, population, household income	More and wealthier people imply more waste, though waste prevention should be a key factor in any waste management strategy. Household income is a major factor in economic assessment of a population.
8) Level of recycling	Waste growth rate, population, household income	More waste implies a greater amount of waste potentially recycled.
9) Methane emissions from waste	Waste growth rate population, household income	More waste, greater amount of methane production and hence share of total target leads to greater amounts captured
10) Level of biodiversity protection	Same as reference level	Easier to communicate benefits by comparing to reference year;
11) Deforestation levels	Deforestation (afforestation) rate	Assume that this continues as current rate unless clearly arguments for other treatment
12) Level of cropland degradation	Same as reference level	Easier to communicate and calculate
13) Level of rangeland degradation	Same as reference level	Easier to communicate and calculate
14) Uptake of RES	Population, per capita energy use	As the target is based on % share of energy supply, and energy use depends on population and per capita use
15) Climate change adaptation	GDP, population (Urban population share if available)	Different models and assumptions behind the different baselines – depending on the assumptions used by different literature sources

The above table notes the key parameters used to help define common baselines for the parameters assessed across the country reports in the ENPI study. As noted earlier, it is possible to opt for more complex baselines (e.g. using modelling with wider range of drivers integrated). What is best to do depends on what data and models already exist, what resources are available (modelling can be resource intensive) and the objective of the assessment (as a pragmatic assessment to highlight that an issue is worth looking at seriously (the objective here), and a specific assessment of the potential benefits and costs of a national policy proposal, require different levels of analysis.

Assumption: The rate of change in policies to achieve the targets

Previous benefit studies' methodologies have assumed a linear improvement from the reference year to the full implementation year. A linear approach was also adopted in this study for most of the parameters. Future studies could take into account other alternatives, such as quick start (in policy/measures implementation to achieve the targets) to get the benefits early, or slow start (e.g. in case of initial financial resource scarcity) but later acceleration (when resources become available) to meet the deadline - 'just in time' solutions.

It should be noted that some countries covered by the project have already defined their own environmental targets and aim to reach them somewhere between 2010 and 2020. However, for the project, the benefit assessment did not consider national targets and changes to environmental policy between now and 2020. This means that the baseline scenario is a 'no action' scenario and only takes into account projected demographic and socio-economic trends. The country analyses assessed the benefits of environmental improvements regardless of national planned policies. Where such plans are already in place, the BA can be used to emphasise their importance.

3.4 The targets

For the purpose of the project, a set of targets for environmental protection were established for each parameter to be measured in the BA. These targets were applied to all the countries covered by the project, in order to provide one single reference scenario for all the countries. In a few cases, some country variants were also adopted to complement the cross country common assessment (e.g. for RES).

The targets are based mainly on selected international protocols, conventions and/or standards and, in some cases, on rules of thumb. An overview is provided in Table 3.1 below. The targets are also presented in more detail in chapters 5-9. Different targets can be used for future BAs, depending on local circumstances, level of progress in environmental policy and existing (or proposed new) national targets/objectives.

Table 3.2 Overview of selected targets for each parameter used in this study

THEME	PARAMETER	TARGET (ENPI)	Rationale for target
AIR	1) Ambient air quality	WHO guidelines for SO_2, NO_x, PM, O_3 and CO Otherwise CO in Air Framework Directive	Based on Gothenburg Protocol (GP) for ENPI East with specific targets. Others: e.g. WHO guidelines or GP-equivalent % reductions concentration.
WATER	2) Connection to safe drinking water	100% connection (except isolated rural areas) to safe and reliable piped water supply.	Rule of thumb - reduce the spread of water borne diseases, incidence of illness from poor water quality and social amenity of access to quality water.
	3) Level of sanitation and hygiene	100% connection to sewage network (except isolated rural areas). Hygiene practices adequate for protection of health.	Rule of thumb - major benefits from improved sanitation / hygiene in households.
	4) Level of waste water treatment	100% secondary treatment in urban areas and main rural areas (>10,000 pop).	Realistic target – primary treatment being insufficient to address environmental concerns, tertiary treatment being likely too advanced /costly.
	5) Surface water quality	Various percentages of rivers and lakes improved to WFD good status (e.g. 85%, 65% etc. depending on current status).	Inspired by EU Water Framework Directive & Bathing Framework Directive. Also: CBD COP10 Target #8: By 2020, pollution, including from excess nutrients, has been brought to levels that are not detrimental to ecosystem function and biodiversity.
	6) Water resource use	Lower Water Exploitation Index (WEI) by 20-40%.	Sustainable use and allocation is essential for meeting demand (at economic value, price of water). It depends on local conditions which most likely can only be established using a case study.
WASTE [11]	7) Waste collection coverage	100% coverage of population with at least a bring-system for waste collection.	Rule of thumb – modern environmental infrastructure for modern state.
	8) Waste treatment	50% recycling (glass, paper, plastic, metals). 65% of biodegradable waste diverted from landfills.	Inspired by EU waste legislation.
	9) Methane emissions from waste	Up to 50% capture.	Considered a reasonable level and used in previous benefit studies.
NATURE	10) Level of biodiversity protection	Two area targets: reach at least 17% of total land area and 10% marine area covered by protected areas (PA);	Johannesburg WSSD target, MDG: slow biodiversity loss + CBD COP10 Strategic Plan for 2011-2020: Target #11 - 17% land area, 10%

[11] It should be noted that waste prevention, a key factor of the EU waste management strategy, should be a key factor in any waste management strategy

THEME	PARAMETER	TARGET (ENPI)	Rationale for target
		100% of PAs in favourable condition status.	marine area covered by protected areas.
	11) Deforestation levels	Halt deforestation by 2020.	CBD COP10 Strategic Plan target #5: By 2020, the rate of loss of all natural habitats, including forests, is at least halved and where feasible brought close to zero, and degradation and fragmentation is significantly reduced.
	12) Level of cropland degradation	Improve land quality to reduce crop yield losses from degradation by half.	
	13) Level of rangeland degradation	Improve rangeland fodder productivity to reduce fodder losses from degradation by half.	
CLIMATE CHANGE	Deforestation	*(covered under nature)*	Preserve carbon storage and sequestration values of forests – *Green carbon.*
	Methane emission from waste	*(covered under waste)*	Methane, a key green house gas (GHG), has high global warming potential (GWP).
	14) Uptake of RES	At least 20% of energy demand supplied by RES by 2020.	Inspired by EU policy.
	15) Climate change adaptation	Keeping temperature rise to 2° Celsius.	International Panel for Climate Change (IPCC)

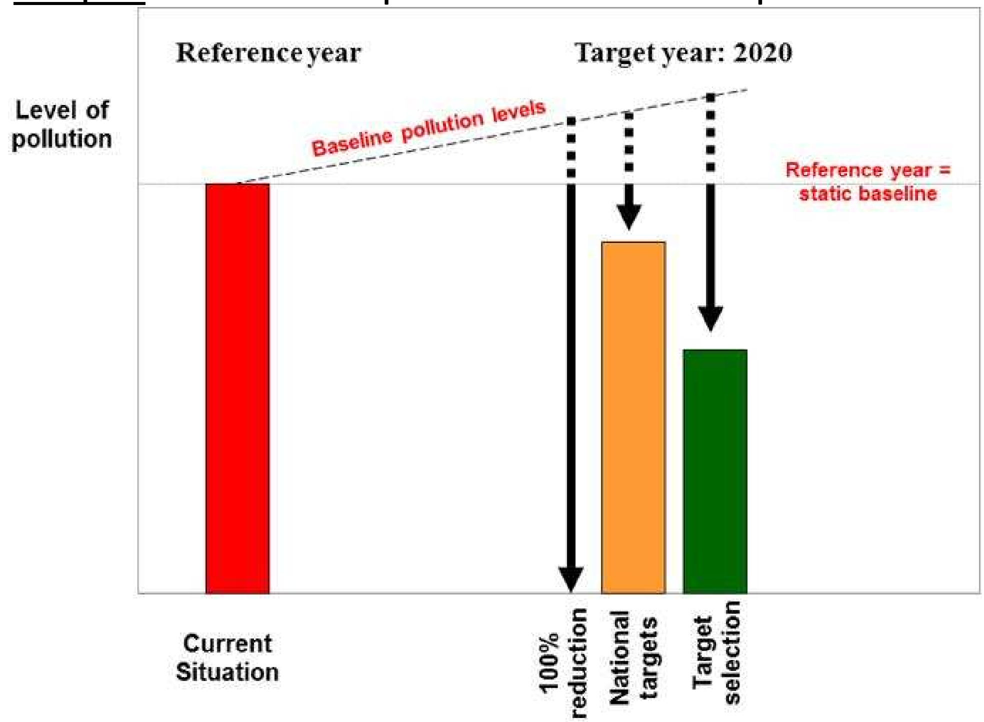
3.5 The environmental improvements

The environmental improvements arising from the adoption of the proposed targets should be assessed by comparing the business-as-usual baseline scenario (i.e. the state of the environment in 2020 if no further action/policy is undertaken), and the target scenario (i.e. in which the proposed targets were met in 2020). The difference between the two cases (e.g. the reduction in ambient air emissions or the increase in the number of households connected to the sewage network) represents the size of the environmental improvement.

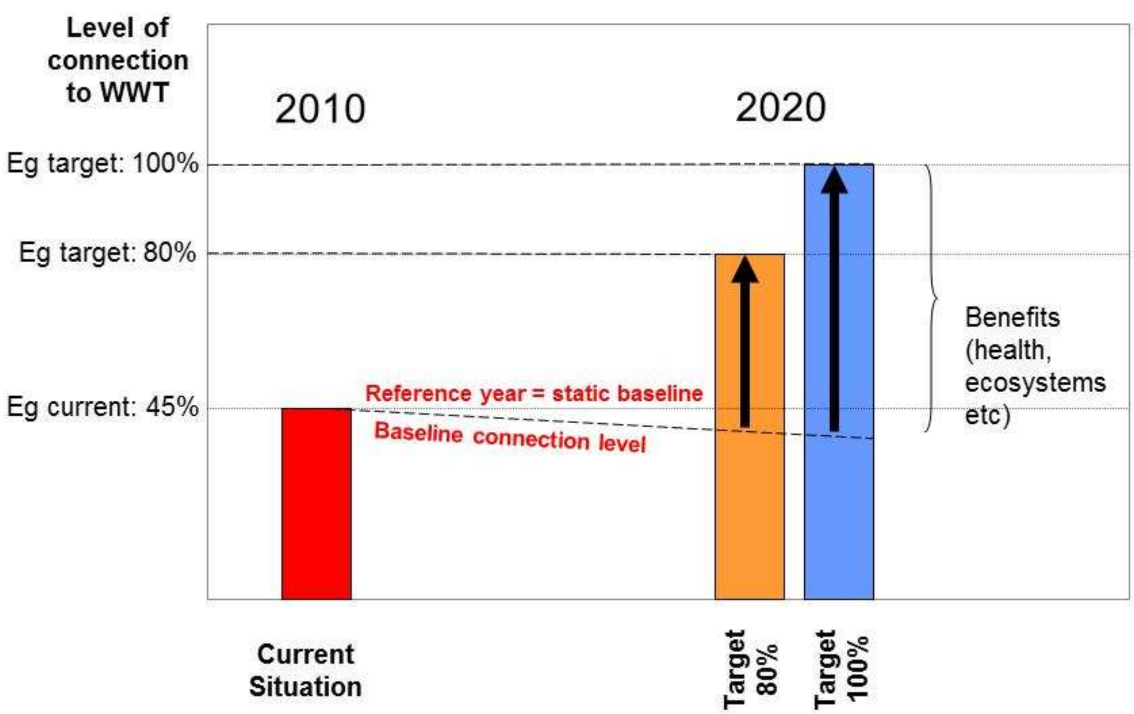
Figures 3.1A to 3.1C illustrate the approach as applied to air pollution and access to clean water and deforestation. As noted above (section 3.3), where it is not possible (or not necessary) to establish a baseline scenario, then the target should be compared to the reference level – i.e. the state of the environment today.

Figure 3.1 Environmental improvements: comparison of 2020 target with 2020 baseline and current reference level – illustrative

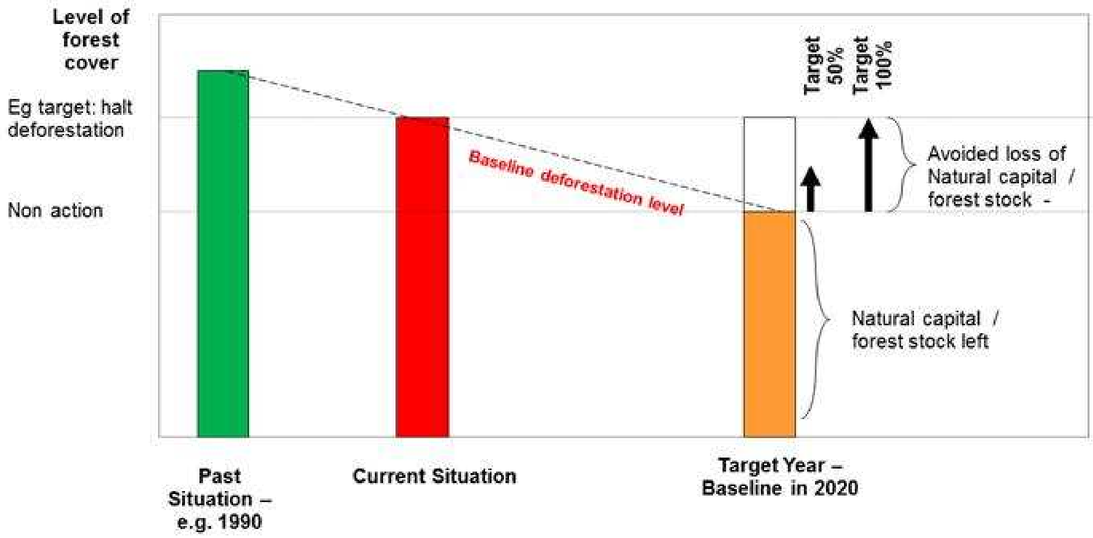
Example A: Environmental improvements from reduced air pollution



Example B Environmental improvements from increased connection to sewage and waste water treatment (WWT) plants



<u>Example C</u> Avoided environmental losses from halting deforestation



> **Assumption: The timescale**
>
> The timescale assumed under the project for the adoption of the targets was 10 years from the present time (2010), making the target year 2020.
>
> This timescale is meant to reflect the time that may elapse before improved environmental policies and legislation are implemented under an ambitious scenario. The timescale of policy change and implementation is typically quite long. For example, the timescale for the implementation of the water framework directive (WFD) within the EU has been more than 25 years. Some improvements may become evident before this, e.g. benefits from greater access to safe water, and some will take considerably longer e.g. the benefits from mitigating the impact of climate change.
>
> For the present project, a relatively short timescale (10 years time) was preferred, in order to identify the benefits of targets *within* a policy-maker's timeframe.
>
> A 2050 timescale could also have been used as an 'ideal' environmental vision. But while this is attractive - in the sense that it seems more realistic/easier to achieve and politicians could agree with the target and de-anchor it from the political short term realities and challenges - it would hardly prove a strong motivation for immediate action. 2030 could be a more realistic timescale when considering large-scale change at a habitual ambition rate. Meeting the targets by 2020 may in some cases require a paradigm shift in ambition, placing environmental issues much higher on the policy agenda.

3.6 The benefits

The final step of the BA methodology focuses on the assessment of the actual benefits arising from the environmental improvements associated with the implementation of the targets.

An assessment should be made for each of the 4 benefit categories listed in Section 2.2, namely: *Health benefits, Environmental benefits, Economic benefits* and *Social benefits.*

It should be noted that not all of these categories may be applicable/relevant to all the parameters whilst some benefits may be related to more than one parameter (e.g. health benefits arises from a combination of improved drinking water quality, sanitation and hygiene and waste water treatment). Only the benefits that are relevant should be analysed and double counting should be avoided. Further details on the type of benefits associated with each parameter and how to assess them are provided in chapters 5-9.

As noted in section 2.4, the benefit should be assessed in terms of one or more levels of the following three-stage approach: in *qualitative terms*, in *quantitative terms* and in *monetary terms.* In the cases where monetary assessments are possible, it is important to also note the quantitative and qualitative benefits as well, to be able present a complete picture. It is also helpful to present a spatial perspective too – i.e., where the benefits accrue (e.g., which cities will benefit from reduced risk of air pollution, which rivers from improved water quality etc.).

An example of the application of this three-stage approach is provided for ambient air pollution in the box below.

Box 3.1. Example of assessment of benefits arising from improved air quality

Assessing the benefits from environmental improvement may be a difficult exercise, depending on the data available and the assumptions needed. As a rule of thumb, one should aim to first provide a qualitative description in order to capture as many benefits as possible, including those for which no data is available.

Whenever the data allow, the benefits to society should be expressed in an appropriate quantifiable measure (e.g. number of cases of respiratory disease or percentage of the population affected) to enable the scale of the benefits to be demonstrated. Where monetary data are available, this measure should be converted to an equivalent monetary value.

The process is illustrated below for the case of improved Air Quality

QUALIFY

Provide a simple description of the origin of the benefit, e.g. a reduction in urban ambient air pollution will lead to health benefits via reduced cases of morbidity and mortality (e.g. due to respiratory diseases), will provide economic benefits via reduced damage to buildings and infrastructures (e.g. caused by smog), can improve amenity and hence increase recreation and tourism potential (e.g. in cities) leading to further economic and social benefits.

QUANTIFY

Calculate the reduction of pollutants concentration (e.g. PM10) arising from the application of stricter environmental targets. On the basis of the number of cases of morbidity/mortality associated to PM10, assess the total reduction of mortality and morbidity cases (e.g., in DALY lost).

MONETISE

Multiply the number of cases calculated above by the unit value (e.g., WTP), for the health outcome in order to provide an estimation of the total monetary value of the reduced cases of morbidity/mortality.

4 PRACTICAL ISSUES: DATA GATHERING, MONETARY ASSESSMENT, PRESENTATION OF RESULTS AND SENSITIVITIES

4.1 Data gathering: key information required and potential sources

A benefits assessment requires the collection of a significant amount of data in order to make the analysis as solid and well informed as possible. However, a full set of data may not be available in each country. An important part of the analysis is therefore to identify data gaps, possible methods to overcome the gaps, and to determine how remaining gaps and/or solution affect the assessment, conclusions and recommendations.

The data collected should include:

- General data on the current economic and social state and trends (GDP, GDP/capita, population size and growth rate etc.);
- Data describing the current state of the environment (and, when possible, trends) with respect to each thematic area of air, water, waste, nature use and the cross-cutting climate change topic;
- Data that measure the relationship between environmental change and socio-economic benefit (where available);
- Data on the valuation of benefits (where available).

Data can be gathered from the following sources:

- national reports and databases: these may include, but are not limited to, national State of the Environment Reports and national statistical reports;
- relevant peer-reviewed published research studies;
- personal contacts with relevant authorities and experts; and
- international reports and databases: these may include publications commissioned or funded by international organisations (UNEP, UNDP, World Bank, OECD, European Commission, Eurostat, European Environment Agency etc.) and can either be country specific or cover several countries or a region.

A list of useful sources of information is provided in Annex I.

Furthermore, a comprehensive **checklist** of the information required for each of the five themes included in the BA was developed for the ENPI study. This is available in Annex VI. Future BAs can develop similar lists adjusted for the parameters to be covered and resources available, to make sure the key data are collected.

4.2 How to calculate the monetary value of benefits: unit values

As noted above, the monetary assessment builds on the quantitative assessment of the scale of the benefits for each measure, and multiplies those quantitative values by a money unit value (or range of values) to convert it to a monetary figure. The table below gives an overview of the factors for each environmental issue that have been monetised under the project and also the type of unit value to be used for the calculations (details are provided in chapters 5-9).

Table 4.1 Overview of issues for monetisation – summary

	Issues for monetisation	*Unit values (type)*
1) Ambient air quality	Avoided health impacts – morbidity, premature mortality	Value of statistical life (VSL); willingness-to-pay (WTP) for avoiding a case of illness; value of loss of life years and range of others (see Table 3.4)
2) Connection to safe drinking water	Avoided health impacts - morbidity and mortality (alternatively, the number of people who gain satisfaction of access to safe drinking water)	Value of statistical life (VSL); willingness-to-pay (WTP) for avoiding a case of illness (alternatively: Willingness to pay (WTP) for access to supply of drinking water of good quality, on a per capita or household basis or as % of household income)
3) Level of sanitation and hygiene	Avoided health impacts – morbidity, premature mortality	Value of statistical life (VSL); willingness-to-pay (WTP) for avoiding a case of illness
4) Level of waste water treatment	No general monetisation; noted case nuggets if available	No general monetisation (benefits picked up in the water quality measure)
5) Surface water quality	Number of people who gain satisfaction of clean river/lake and coastal water	WTP for access to clean water (for recreation, tourism etc.) on a per capita or household basis or as % of household income
6) Water resource scarcity	No monetisation. However, in future studies the monetisation could entail the potential value added of water augmentation/substitution (from desalination or bulk water import) that would generate benefits greater than the cost (domestic, industrial and agricultural uses)	No monetisation (some economic 'nuggets' in cases on costs of augmentation / substitution / lost outputs)
7) Waste collection coverage	Amount of waste collected. Number of people who gain satisfaction of better waste collection system	Yearly value of avoided clean up costs; and WTP for improved collection system (as % of household income)
8)Waste treatment	Amount of waste recycled (by type: paper, metal, glass and plastic)	Average value of plastic, metal, glass and paper for recycling – avoided resource costs
9) Methane emissions from waste	Total tons of methane emissions avoided in CO_2 equivalent	Total MT CO_2 equiv. avoided emissions & range of €/tCO_2 values
10) Level of biodiversity protection	No general monetisation; noted case nuggets if available	No general monetisation - some ecosystem services (e.g. carbon storage/sequestration) captured under other issues)
11) Deforestation levels	Avoided emissions of CO_2 from avoided deforestation	Total MT CO_2 emissions avoided and sequestered & range of €/tCO_2 values
12) Level of crop land degradation	Increased agriculture productivity due to improved crop land management	Agricultural growth and degradation rates; area under agricultural crop cultivation; real prices of agricultural crops – value lost/at risk from degradation
13) Level of rangeland degradation	Increased fodder productivity due to improved rangeland management	Area of rangeland; real prices of livestock fodder
14) Uptake of RES	Avoided emissions of CO_2 from avoided deforestation	Total MT CO_2 avoided & range of €/tCO_2 values
15) Climate change adaptation	Monetisation only if done in available literature.	Depending on the literature available

Some of these values are common for all countries – e.g. CO_2 values – and others are more dependent on the country and its economic situation e.g. Willingness to Pay (WTP) for the connection to safe drinking water, which is typically affected by the level of income in the country (and region). There is often no single number for such a calculation, although averages or a range of values can be used. The table below presents an overview of the units that can be used for each parameter and their values. Further guidance is given in chapters 5-9. The values below have been used in the project as the 'starting point' for the benefit transfer (see section 4.3 below), taking different country contexts into account.

Table 4.2 Unit values and their ranges - summary

	Unit	*Unit value for references year (2008)*	*Unit values for target year (2020)*
1) Ambient air quality	Mortality (children and adults) Morbidity Respiratory, cardiac hospital admission Consultations with physicians Restricted activity day Restricted activity day (adjusted) Minor restricted activity day Use of respiratory medication Symptom days	VSL in the range of €0.15-5-1.5 million (PPP[12] adjusted), depending on country income level. Valued in terms of cases of chronic bronchitis-equivalents in the range €0.03-0.27 million (PPP adjusted), depending on country income level. EU-27 average ref values € 2,050/admission € 58/consultation € 140/day € 90/day € 42/day € 1.3/day € 42/day	This is assumed to grow at the rate of GDP/capita in PPP growth over the period to 2020 *Source [European Commission 2000] 2008 prices*
2) Connection to safe drinking water	Mortality Morbidity (diarrheal illness)	As per air WTP to avoid a case of diarrhoea in the range of €18-172 (PPP adjusted), depending on country income level [13]	As per air
3) Level of sanitation & hygiene	Mortality Morbidity (diarrheal illness)	As per drinking water	As per air
4) Level of waste water treatment	No monetisation	No monetisation	No monetisation
5) Surface water quality	Annual Willingness To Pay by households in the country for the achievement of nation-wide improvements in river water	Not unit values, but rather a statistical relationship. Benefit function transfer method	Benefits in water quality improvements relative to GDP in 2020 are in the range

[12] Purchasing power parity (PPP) between two countries, A and B, is the ratio of the number of units of country A's currency needed to purchase in country A the same quantity of a specific good or service as one unit of country B's currency will purchase in country B (World Bank, 2008b)

[13] WTP for avoiding a case of illness is, as for VSL, assumed to vary in proportion to PPP adjusted GDP per capita across countries.

	Unit	Unit value for references year (2008)	Unit values for target year (2020)
	quality by 2020 (€ PPP per household per year).	employed. Results illustrate the range of monetary benefits in the specific country from an improvement in river quality from current conditions to Good Ecological Status (GES), objective of the EU Water Framework Directive (WFD). The monetary benefits are equal to the estimated amount of money that households in each country of the region would be willing to pay for improved surface water quality by the year 2020 (see results in right hand column). Note: In previous BA studies low and high unit values for WTP have been used. , adjusted by GDP/capita.	of 0.1 – 1.0%, or €31-240.per household (PPP adjusted)
6) Water resource scarcity	No monetisation	No monetisation	No monetisation
7) Waste collection coverage	Yearly value of avoided clean up costs; and WTP for improved collection system (% of household income)	1% of household income	1% of household income in 2020
8)Waste treatment	Average value of plastic, metal, glass and paper for recycling	Country specific	Country specific
9) Methane emissions from waste	Total MT CO_2 equivalent avoided & range of €/tCO_2 value	2008: low € 17.2 – high € 32	2020: low € 39- high € 56
10) Level of biodiversity protection	No monetisation	No monetisation	No monetisation
11) Deforestation levels	Total MT CO_2 avoided & range of €/tCO_2 value	2008: low € 17.2 – high € 32	2020: low € 39- high € 56
12) Level of crop land degradation	Agricultural productivity	Country specific – where available: € per tonne of increased crop output using world prices for cereals and domestic producer prices for non-cereals	Real prices of cereals and non-cereals increase at a rate of 4% and 3%, respectively, per year over the period to 2020
13) Level of rangeland degradation	Livestock fodder productivity	Country specific – where available: € per tonne of increased fodder output	In this study, not assessed for 2020
14) Uptake of RES	Total MT CO_2 avoided & range of €/tCO_2 value	2008: low € 17.2 – high € 32	2020: low € 39- high € 56
15) Climate change adaptation	Depending on the literature available	Depending on the literature available	Depending on the literature available

4.3 How to calculate the benefits monetary value: benefit transfer

The literature and data collection on benefits valuations carried out within the ENPI study revealed that the number of environmental valuations available for these countries is not extensive and that domestic valuation evidence bases (needed to build the BA analysis upon) did not generally exist (e.g. domestic WTPs were not available and hence could not be integrate into the BA calculations). Therefore, under this project, some information (e.g. monetised benefits to consumers etc.) had to be 'borrowed' from other benefits analysis using a 'benefit transfer' approach.

A 'benefit transfer' (see White et al (2011), in TEEB (2011)) is a method of estimating economic values in the study location (e.g. Egypt) by using values already developed in other studies (e.g. from UK). It is a pragmatic way of dealing with information gaps and resource (time and money) constraints. This is important as there are rarely enough resources available to conduct a primary (or site-specific) valuation study for every site, ecosystem, service or benefits/cost being assessed.

Benefit transfer is not a new concept and can be considered a practical solution to resource constraints. The basic rationale is that there may be sufficient commonalities in different areas to allow values from one area to be transferred to another. However, this needs to be done with care as values can vary widely depending on local specificities.

The conditions which determine whether benefit transfer can provide valid and reliable estimates include:

- the commodity, issue or service being valued is very similar at the site where the estimates were made and the site where they are applied;
- the populations affected have very similar characteristics, and;
- the original estimates being transferred must themselves be reliable.

There is some scope to factor in differences (e.g. income, environmental conditions) and a range of tools are available including:

- Unit benefit transfer – e.g. multiplying a mean unit value (per household or per hectare) from a similar site by the quantity of the good/ service at the site being assessed.
- Adjusted unit benefit transfer – as above, but adjusting for site characteristics (e.g. income, population levels).
- Value function transfer – e.g. use a value or demand function from one site (e.g. for travel cost) and apply, with parameters for new site (e.g. population, average income), to obtain site specific value.
- Meta analysis (meta-analytic function transfer) – combine value or demand functions from several sites and apply with local site parameters (White et al, 2011).

For this project, a combination was used:

- For WTP benefit transfer, we used the adjusted unit benefit transfer approach – by weighting by population and GDP/capita in PPP terms.
- For carbon a simple unit benefit transfer was adopted.
- For waste a common share of income indicator was used (1 per cent).

It should be noted that some of the values used for a benefit transfer may change over time. For instance, carbon prices are expected to rise over time, reflecting a tightening of policy ambitions, which in turn reflect a need for actions and the increasing appreciation of likely damage from non-action (note that the marginal damage costs can be the basis of carbon prices; others carbon prices focus on the cost of action; yet others on market prices, for example within the EU-ETS).

When a percentage share of household income is used as a term of reference (e.g. 1 per cent income was used to assess the value of improved waste collection), the percentage may stay the same over time, but the total values will rise as household income rises. WTP will also generally increase in line with income (here measured by GDP/capita in purchasing power parity (PPP)[14] terms – which can be calculated nationally, or better yet at a regional or local level). An assumption of linear relationship between WTP and income was considered defensible and pragmatic, and was used for most of the parameters in this project. A 'linear relationship' here means that e.g. a 10 per cent increase in income per capita is taken to imply a 10 per cent increase in WTP; in economic terms this equates to an 'elasticity' of 1. Future country analysis may wish to use different rates for scenarios and sensitivity analysis, and can build on either meta-studies that can help clarify elasticities or domestic analysis of elasticities.

Finally, it should be pointed out that benefit transfers may not be needed if data for the country under analysis are available and/or if ad hoc surveys are carried out in the country (e.g. WTP surveys for access to piped water etc.). This can be a very valid and often preferable alternative, if resources are available.

Annex II includes additional insights on benefit transfers, discussing the use of market prices vs. purchasing power parities (PPP) and presents estimates of VSL for ENPI countries.

[14] Purchasing power parity between two countries, A and B, is the ratio of the number of units of country A's currency needed to purchase in country A the same quantity of a specific good or service as one unit of country B's currency will purchase in country B (World Bank, 2008b)

4.4 Assessing the environmental improvements – how to present results

For the monetisation stage there are several ways of presenting the benefits results:

a) Value of benefits in the target year 2020 - i.e. the annual benefits in 2020
   - in the national currency and in Euros (or other currency)
   - as a percentage of GDP
   - in Euro per capita (or other currency).

b) Cumulative benefits over a time period - e.g. from reference point to 2020 – i.e. aggregating the benefits of moving towards the target over a number of years and calculating a net present value (NPV). This in turn requires the use of a discount rate (see box below).

It would also be possible to answer the question 'what would the benefits be today had the targets been met today?'. This is a simplification of the projection and avoids the need to define a baseline in 2020, and hence requires no assumption of population growth, GDP growth, income etc.

There are pros and cons of each approach. The core approach used in this study, building on the approach successfully used in the past, is to look at the value of the annual benefits in the target year and present the results in total money terms, as a percentage of GDP and in Euro and local currency per capita, as each has a certain potential to communicate the values.

A sensitivity using Net Present Values (NPV) and looking at the benefits today if the targets were met today may be done in future BA studies.

Assumption on discounting: While the core approach is to look at the benefit in the target year, the sensitivity calculating the NPV will require the use of a **discount rate**. A core value of 4 per cent (real) is recommended, as in previous benefit studies. Where appropriate, and if requested, a sensitivity analysis may be undertaken using different discount rates (e.g., 0% 2%, 10% real rates).

Discounting explained[15]: Discounting is important to the analysis of long-term projects. For instance, a 100-year project, yielding benefits of 22,000 EUR on completion, is worth around 8,000 EUR today at a 1 per cent discount rate but only 1 EUR at a 10 per cent discount rate. In general, a lower discount rate will favour ecosystem services as they are expected to continue into the far future and this increases the weighting placed on them. However, this is not always the case as a low discount rate will also favour any project with large upfront costs and benefits further in the future, including e.g. road building that could adversely impact on biodiversity and ecosystem services.

Practice varies considerably. An OECD survey (OECD 2006) of its Member Countries found that the social discount rate used was usually around 4-5 per cent but varied from 3 per cent in Denmark to 10 per cent in Australia. Some countries allowed for declining rates (usually after 30 years). Some argue that the social discount rate should be lower. The Stern Review on the Economics of Climate Change argued for a discount rate lower than any of those used currently used by a government, though this is challenged by the mainstream economics position (see further TEEB 2010).

[15] Based on TEEB 2011, pp. 157

4.5 Synthesis of assumptions and sensitivities

Several assumptions can be made in a BA, for example on the timeline for the benefits to be realised, the discount rates to be used, unit values of WTP and so on. However, having too many in the analysis absorbs resources arguably better spent elsewhere and can detract from the clarity of the message, therefore the number of sensitivities has been limited in earlier studies. The core sensitivities for analysis across countries are:

a) Range of unit values used as inputs to the monetary analysis – e.g. carbon values – upper and lower end;
b) Value of meeting the target in the future (here: 2020) and value today (here: 2008) should the targets be met already today (hypothetical value), and;
c) Range of different discount rates can be used, in the case that Net Present Values (NPV) are used.

Others sensitivities may be country-specific, such as:

- Implementation pathways (e.g. linked to waste management choices);
- Targets – tailoring the general targets suggested in this Manual to the country specific ones, and;
- Baselines – in some cases it may be possible/useful to use different/multiple baselines (e.g. if official studies using different baselines scenarios are available); this can help check the robustness of the results.

A synthesis of assumptions used under the project is noted in the table below. It should be noted that a practical approach with limited sensitivities was chosen for the project. For future/more comprehensive benefits analysis a range of scenarios could be created and a wider range of sensitivity analysis carried out, building on detailed modelling.

Table 4.3 Summary of key assumptions the ENPI benefit assessment

Issue	Assumptions
Timescale	2020
Reference year	2008, if and where data available, and note year if other than 2008.
Targets	Usually a single common target for year 2020 used across the countries for each parameter under analysis.
Baseline	Usually a set of essential factors are included in the baseline projection such as GDP, population and their growth rates. These are kept to a minimum to keep the analysis reasonably simple.
Mortality and morbidity	Valuation of mortality follows a benefit transfer approach of willingness to pay (WTP) for mortality risk reduction that translates to a value of statistical life (VSL) which varies across countries in proportion to GDP/capita (PPP terms). The same WTP and benefit transfer approach is used for valuing an avoided case of illness, unless otherwise stated.
Time development of willingness to Pay (WTP)	Assumes a proportional relationship – e.g. if GDP/capita goes up by a factor of two, the WTP goes up by a factor of two.

4.5.1 Economic and demographic data

The values for GDP and population growth for 2008 and 2020 used under the project are shown in the tables below.

Table 4.4 Economic and demographic values used under the project – 2008 values

	Population, total	GDP per capita (€)	GDP per capita, PPP (€)	GDP (€)	GDP , PPP (€)
year	2008	2008	2008	2008	2008
Algeria	34,373,426	3,310	5,464	113,760,502,540	187,832,928,962
Armenia	3,077,087	2,645	4,153	8,139,729,984	12,779,159,126
Azerbaijan	8,680,100	3,630	5,997	31,512,718,616	52,056,883,880
Belarus	9,680,850	4,256	8,402	41,197,478,562	81,335,010,246
Egypt	81,527,172	1,360	3,709	110,848,720,815	302,385,617,459
Georgia	4,307,011	2,029	3,347	8,737,345,539	14,415,542,281
Israel	7,308,800	18,888	18,921	138,047,438,030	138,288,087,432
Jordan	5,906,043	2,456	3,805	14,506,607,108	22,470,395,351
Lebanon	4,193,758	4,766	8,128	19,989,258,186	34,088,606,694
Libya	6,294,181	10,111	11,066	63,639,140,617	69,648,724,180
Moldova	3,633,369	1,157	2,049	4,203,646,965	7,445,428,279
Morocco	31,605,616	1,891	2,917	59,772,955,223	92,183,046,667
Russia	141,950,000	8,082	13,934	1,147,188,578,552	1,977,991,803,279
Syria	20,581,290	1,832	3,135	37,707,855,926	64,527,404,715
Tunisia	10,327,800	2,666	5,451	27,533,459,467	56,294,975,410
Ukraine	46,258,200	2,663	4,980	123,193,065,321	230,343,086,066
OPT	3,937,309	1,014	2,029	3,993,786,793	7,987,573,586

Source: World Bank (2010) and own calculations.

Table 4.5 Proposed economic and demographic values used under the project - projections to 2020

	Population, projected	GDP per capita (€)	GDP per capita, PPP (€)	GDP (€)	GDP, PPP (€)
year	2020	2020	2020	2020	2020
Algeria	40,590,000	4,212	6,955	170,970,968,798	282,294,620,012
Armenia	3,153,000	3,919	6,153	12,356,951,622	19,400,084,697
Azerbaijan	9,821,000	5,379	8,885	52,824,331,140	87,262,229,124
Belarus	9,262,000	6,305	12,447	58,395,458,774	115,288,493,459
Egypt	98,617,000	1,730	4,721	170,653,317,184	465,527,326,871
Georgia	3,968,000	3,006	4,959	11,925,932,486	19,676,317,395
Israel	8,803,000	24,039	24,081	211,615,568,241	211,984,464,330
Jordan	7,476,000	3,126	4,842	23,370,778,875	36,200,790,238
Lebanon	4,584,000	6,066	10,345	27,808,179,640	47,422,575,153
Libya	7,685,000	12,868	14,083	98,892,553,361	108,231,193,975
Moldova	3,371,000	1,714	3,036	5,778,200,856	10,234,251,451
Morocco	36,161,000	2,407	3,712	87,039,330,302	134,233,795,487
Russia	136,129,000	13,425	23,147	1,827,515,261,845	3,151,016,559,856
Syria	26,405,000	2,332	3,990	61,571,546,414	105,364,041,439
Tunisia	11,695,000	3,393	6,937	39,681,477,015	81,132,840,406
Ukraine	43,067,000	3,946	7,377	169,925,792,908	317,722,685,433
OPT	5,454,000	1,291	2,582	7,041,013,068	14,082,026,136

Source: Population projections from World Bank (2010); GDP projection based on own calculations applied to 2008 World Bank (2010) data – see table below for growth rates applied.

Regional annual growth rate values were applied to the World Bank values in table 4.4. to estimate the projected 2020 GDP values in table 4.5. These regional growth rates are shown in the table below. It should be stressed that these are default values and reflect an expectation for groupings of countries; alternatively, national projections can be used in future assessments, if sufficiently robust.

Table 4.6 Annual growth rates used under the project

Country cluster	Data	Annual growth factor
ENP South	GDP	3.75%
	GDP/capita	2.03%
ENP East	GDP	3.35%
	GDP/capita	3.33%
Russia	GDP	3.75%
	GDP/capita	4.32%

Where: ENP South = Algeria, Egypt, Israel, Jordan, Lebanon, Libya, Morocco, Syria, Tunisia and occupied Palestinian territory (OPT).
ENP East = Armenia, Azerbaijan, Belarus, Georgia, Moldova and Ukraine.
Russia = Russian Federation.

Source: unless otherwise indicated in this report, GDP projections are based on the GDP projections used in the global modeling runs (using the Globio-Image model) for the OECD 2008 Global Outlook to 2030 report[16].

4.5.2 The Value of Statistical Life (VSL)

Improvements in ambient air quality, drinking water, sanitation, hygiene and so on are associated with reductions in the risk of mortality (and risk of illness and increased confidence and satisfaction of users in quality of service or environment). The benefit to society of mortality risk reductions are usually approximated by people's willingness-to-pay (WTP) for such risk reductions (e.g., as captured in life insurance premia). WTP is then converted to a value of statistical life (VSL) that is applied to estimated cases of mortality avoided from the environmental improvements to arrive at an estimate of the monetary benefits of the improvements. VSL has therefore nothing to do with value of life, but rather reflects how people are willing to reallocate their resources from consumption of market goods and services to paying for reductions in the risk of mortality.

Studies of WTP for mortality risk reduction, and thus VSL, have been conducted in many countries around the world. Results from a recent meta-analysis of studies of VSL in over 30 countries (of which nearly half have a GDP per capita in the range of that of the ENPI countries) prepared for the OECD are here used to estimate VSL in ENPI countries (Navrud and Lindhjem, 2010)[17]. These values, for each country for the year 2008 and 2020 in €PPP and in local currency, are shown in table 4.7 below.

A discussion on the controversial issue of the variation of value of statistical life across countries in provided in Box 4.1 below.

Table 4.7 Estimated value of statistical life (VSL) in ENPI countries

	VSL (€ PPP), 2008	VSL (LCU), 2008	VSL (€ PPP), 2020	VSL (LCU), 2020
Algeria	419,008	23,886,257	533,281	30,400,641
Armenia	316,529	90,389,617	468,954	133,916,996

[16] OECD (2008) *Organisation for Economic Cooperation and Development: Outlook to 2030.*Paris.

[17] Navrud and Lindhjem (2010) rely on a database of over 1000 estimates of VSL from multiple studies in over 30 countries (www.oecd.org/env/policies/VSL). Nearly half of these countries are non-OECD countries with a GDP per capita in the range of that of the ENPI countries. Based on the meta-analysis of the VSL studies Navrud and Lindhjem recommend the following empirically estimated equation to estimate VSL in countries in which there are no original VSL studies, such as the ENPI countries:

$$VSL = e^{(4.1419+1.022\,ln(gdp))} \qquad (1)$$

where *VSL* is expressed in purchasing power parity (PPP) adjusted US$ and *gdp* is GDP per capita in PPP adjusted US$. VSL is then converted to PPP adjusted Euro as well as local currency units of the ENPI countries. As can be seen from (1), VSL varies across countries in proportion to their PPP adjusted GDP per capita level. The equation is ln(VSL) = 0.0433 + 1.022 ln (gdp) – 0.445 ln(r), and here using a risk reduction r=1/10000 (see Annex 2).

	VSL (€ PPP), 2008	VSL (LCU), 2008	VSL (€ PPP), 2020	VSL (LCU), 2020
Azerbaijan	460,803	336,782	682,704	498,961
Belarus	650,350	1,031,931,969	963,527	1,528,861,765
Egypt	281,987	833,061	358,892	1,060,258
Georgia	253,889	331,426	376,150	491,025
Israel	1,491,002	7,760,987	1,897,636	9,877,603
Jordan	289,420	197,357	368,352	251,182
Lebanon	628,743	822,193,776	800,217	1,046,426,730
Libya	861,764	1,409,812	1,096,788	1,794,303
Moldova	153,774	1,329,991	227,824	1,970,451
Morocco	220,577	1,625,356	280,735	2,068,631
Russia	1,090,701	29,437,594	1,811,827	48,900,494
Syria	237,485	9,462,892	302,253	12,043,661
Tunisia	417,937	369,846	531,919	470,712
Ukraine	381,041	1,574,310	564,532	2,332,423
OPT	152,202	399,746	193,712	508,767

Notes: PPP=purchasing power parity adjusted. LCU=local currency units (not PPP adjusted).

Box 4.1 Valuing Life

Significant controversy surrounds the valuation of impacts to human health, and particularly mortality. This relates to two principal issues: the 'moral' issues of 'valuing life', and the methodology by which values for health impacts are calculated. Much of the reaction to the monetary valuation of mortality stems from the unfortunate choice of terminology, such as 'the Value of a Statistical Life'. This does not mean the 'value of life' as used in everyday language, but is simply a convenient way to summarise information about people's willingness to pay for reductions in mortality risk. This makes it easier to compare the benefits of measures designed to reduce mortality with the associated costs if the aggregate WTP and the number of lives saved are known. Because of the high percentages of total benefits attributed to improvements in health, the methodologies and assumptions by which these benefits are calculated are particularly crucial. A principal area of concern is the value placed on changes in the risk of premature mortality. In some previous benefit studies, the approach taken has been to adopt VPF (Value of Prevented Fatality)[18], given the concerns regarding the use of the alternatives, like the Value of Life Years (VOLY) approach. In order to tailor VSL values to different countries, estimated values are weighed by the relative per capita purchasing power parity (PPP) ratios. Sensitivity analyses could also use different weighting (e.g. using income elasticities), or use no weighting at all across countries to avoid the ethical problems of suggesting that the value of life differs across countries In the ENPI report the analysis focused on PPP adjusted values, which gave a more conservative estimate.

It should be stressed that using this approach, for example in the context of health benefits or biodiversity, implies that the value of a statistical life or an ecosystem will be less in the ENP countries than in the EU. Although this is usually acceptable in neo-classical economic theory, it clearly raises difficult ethical choices in the use of the benefit estimates. In practice, it can be useful to use both adjusted (i.e., 'accepted' economics technique) and non-adjusted (i.e., more morally acceptable) and present a range (as was done in Ecotec et al 2001). The use of adjusted numbers will lead to lower overall benefits value and hence more conservative estimates – if the analysis leads to the conclusion that there are significant benefits from environmental improvements, the case would be stronger still with the unadjusted values. Note that using higher unadjusted values may open the analysis to criticism from a different angle – namely of using unrealistically high numbers to get a desired result.

It is important to reiterate that the aim of this analysis is to highlight the importance of avoiding pollution causing illness and premature mortality. The VSL is therefore an indicator and not a statement of the worth of life, and a tool to help motivate action to avoid loss of life-years or loss of quality of life. All BA studies need to be very clear on this, given the controversy about valuing life for economic analysis.

In this context, the European Commission, DG DEVCO F3, as financer of this study, would like to stress that it had suggested the use of regional average figures for 'value of statistical life' in the framework of this study, as opposed to national VSL-figures.

4.5.3 Carbon values

There is no single estimate for the cost of CO_2 but rather a range of estimates dependent on what is measured (e.g. cost of achieving a target, or level of damage due to climate change to avoid), the model used and the assumptions made (e.g. level of trading, use of CDM), the type of values taken into account (traded values or non-traded values) and timescale. Care is needed as regards whether the cost of 'carbon' (C) reduction or of 'carbon dioxide' (CO_2) reductions is being quoted. Carbon weighs 12/44 CO_2.

A range of values was used for this ENPI assessment. European Commission values (EC 2008 and DECC 2009) were adopted as the lower value for 2010 and 2020, and the values from a study by the French Centre d'Analyse Stratégique (2009) as the

18 VPF is the term increasingly used. It represents the same value as VSL (Value of Statistical Life, sometimes known as VOSL), but adopts a different nomenclature.

upper range. These are summarised in table 4.8 below. These were considered to provide a fair range that also reflects work in the UK, World Bank and other estimates (see table 4.9). These values are higher than the current values in the EU-ETS market. While at first sight this could lead some to argue that lower carbon values should be used, it should be noted that the benefits of action to address climate change are fundamentally linked to avoided damage; the current carbon market prices are considered significantly below the expected marginal damage costs, therefore using them would lead to a potentially significant underestimate in the benefits of addressing climate change. Indeed, even the use of costs of action lead to underestimates of the benefits of action.

For the project, common carbon values were adopted across all countries. These were applied in different parameters: for emissions savings from increased RES and from methane capture, and from avoided emissions from deforestation and degradation. The former two areas are generally in the domain of traded emissions; for degradation and deforestation this is still under debate/negotiation. For the sake of simplicity and without suggesting that carbon saved from avoided deforestation and degradation would be traded and fungible with other carbon, a common CO_2 value was used.

Table 4.8 Carbon value used in this study (€/t)

GHG	Range	2010	2020
Carbon dioxide (CO_2) or CO_2 equivalent	Low	€ 17.2	€ 39
	High	€ 32	€ 56

Table 4.9 Range of values for CO_2 from international studies (a selection)

	Date	2009 GBP	€/tonne CO_2
New Carbon Finance	May-09	36.8	46.1
DB Research	May-09	34.9	43.8
Barclays Capital	May-09	28.	36.1
Société Générale	May-09	27.3	34.2
European Commission	IA 2008 (for 2020)	31.	39.0
DECC (UK)	Latest: core	25.1	31.5
	low	14.2	17.8
	high	31.3	39.3
French government	value for 2010		32
	value for 2020		56

EC (2008; DECC (2009); and Centre d'analyse stratégique (2009).

The following chapters 5-9 describe step by step how the methodology presented above (chapter 3) should be used for the assessment of each of the parameter (covered by the ENPI project). For each, information is provided on:

Definition of parameter, *including:*

- *Short definition*
- *Unit of measurement (indicator)*
- *Rationale for choice*

Methodological steps, *including:*

- *State of the environment (at reference point)*
- *BAU baseline*
- *Target*
- *Environmental improvements*
- *Benefits assessment: qualitative, quantitative, monetary*

As noted earlier, there may be additional parameters that countries could focus on, different targets, and/or additional sensitivity analysis to integrate other domestic considerations. The methods described below could therefore be seen as a toolkit of methods and helpful guide for future BA, which can be adapted and extended for countries wishing to do further analysis.

5 METHODOLOGY FOR ASSESSING AIR RELATED BENEFITS

This part of the analysis covers the benefits related to improved air quality, both through stationary (e.g., power and industrial plants) and moving (e.g., transport) sources. It covers the following sub-theme and parameter:

- Sub-theme: Air quality
    - Parameter: Ambient Air Quality

The analysis aims to explore how the current level of air pollution is affecting society, especially in terms of health, and to determine the benefits that may occur from improving ambient air quality.

To do so, information is needed on the concentration and/or levels of emission of specific air pollutants, notably SO_2, NO_x and particulates from national and key point sources. Relevant data is also needed to determine the number of people exposed to poor air quality (e.g. total population data for major cities) and likely health impacts (e.g. bronchitis, asthma, cancer and early mortality). Data on current trends in pollution levels and respiratory health is also important.

5.1 Sub-theme: AIR QUALITY

This sub-theme concerns the benefits from improved air quality, as assessed by the ambient levels of a number of pollutants including ozone (O_3), particulates (PM), volatile organic compounds (NMVOCs) and sulphur dioxide (SO_2). The benefits from reductions in the ambient levels of these pollutants are considered together in this assessment. Thus, benefits are not assessed for each individual pollutant separately.

5.1.1 Ambient air quality

<u>Definition of the parameter</u>

The air quality parameter assesses the aggregate health improvements attributable to the national population as a result of improved air quality. It also assesses other improvements such as in crop yield, material damage and ecosystem quality.

Rationale for choice: The different air pollutants considered in this assessment are associated with a range of health conditions that include various respiratory and cardio-vascular illnesses as well as premature death. A number of these health conditions have established incidence rates associated with given ambient levels of the individual pollutants. Therefore, these relationships can be utilised to derive quantitative estimates of the health impacts of given air pollution levels; health benefits of reducing pollution levels can then be measured. Previous assessments demonstrate that health improvements are likely to be the most important group of benefits resulting from improvements in air quality. However, crop yield and material damage benefits are also included in the monetisation method below.

Methodological steps

The principal methodological steps are:

1. *State of the environment:* To describe the state of the environment (air quality and associated impacts) at the reference year (e.g. 2008), including current emission levels of the main air pollutants.
2. *BAU baseline*: To project the state of the environment under a baseline scenario to the year(s) of relevance to the policy maker (e.g. 2020).
3. *Target*: To set a target/strategy and define the state of the environment under a policy scenario i.e. where an air quality strategy has been implemented and has been effective.
4. *Environmental improvement*: To describe the change (improvement) in environmental quality as a result of moving from the baseline scenario to a policy scenario in a given year in qualitative and quantitative terms.
5. *Benefits assessment*: To value the identified change in environmental quality (quantitative).

These steps are described in more detail in the following paragraphs so as to facilitate the undertaking of further independent assessments by policy makers and supporting analysts. An illustrative example is used to demonstrate how the quantitative method works in practice. Some additional information is provided in Annex III.

Data needed: see data checklist in Annex VI.

Step 1. Describe the state of the environment (at reference point: e.g. 2008 and/or most recent year available)

In the first instance it is suggested that the analyst provide a description of the current state of air quality. In particular, it is helpful to provide a brief overview of:

- Which areas in the country are known to have poor air quality (e.g. particular towns and/or regions);
- Recent trends in air quality, as measured by data on individual air pollutants;
- Any evidence that has linked air quality to health or other effects within the country, including qualitative discussions e.g. in newspapers, or scientific studies that quantify impacts;
- Emissions sources (point sources e.g. industry and energy and non-point sources e.g. transport[19]), noting which ones are the main sources and including statistics on their contribution to national emission levels if available. In specific cases, air pollution could emanate from slash and burn, dust from mining processes (e.g.

[19] Note in some cases transport can also be a point source e.g. ships in ports constitute an increasing point source of pollution.

cement and phosphate), dust during sand storms and waste burning (peri-urban and rural areas).

Country-specific emissions data for the year 2005 is presented in Table 5.1 below. This data may be used as a common starting point for the benefit assessment work in ENPI countries, with due assumptions regarding future projected emission levels. Note that this data is modelled on the basis of observed energy, industry and transport patterns in these countries. Where observed emissions data is available this should of course be substituted for this modelled data. For future assessment, it will be useful to see if either updated information exists, whether modelling or measurement based.

Table 5.1. Pollution emissions by country in 2005 (thousand tons)

	NH3	NMVOC	NOx	PPM2.5	PPMco	PPM10	SO2
Algeria	56	856	195	5	2	7	85
Egypt	399	1051	445	437	268	704	740
Israel	26	262	246	40	24	64	245
Jordan	13	126	91	35	21	56	135
Lebanon	14	66	69	22	14	36	185
Morocco	105	168	154	172	105	277	491
OPT	21	120	58	20	12	32	92
Syria	78	383	243	120	74	194	417
Tunisia	41	117	53	57	35	93	253
Total	754	3147	1553	908	555	1463	2643
Armenia	17	101	6	16	10	26	8
Azerbaijan	64	318	76	18	9	27	135
Belarus	165	366	84	29	14	43	134
Georgia	39	68	16	7	3	10	5
Moldova	21	73	14	25	21	46	7
Russian Federation	1068	8394	4297	947	569	1516	6710
Ukraine	306	838	544	305	202	507	863
Total (rounded)	1680	10159	5036	1348	827	2175	7863

Sources for baseline emissions: European Commission, Joint Research Centre (JRC)/Netherlands Environmental Assessment Agency (PBL). Emission Database for Global Atmospheric Research (EDGAR), release version 4.1. http://edgar.jrc.ec.europe.eu, 2010'; Megapoli, contributed by TNO, 2010

Summary of key data needs (see also data checklist in Annex VI):

Data needs for benefits assessments include:

- Key problems/issues related to air quality across the country (e.g., where are there high pollution areas, or high levels of health impacts);
- Emissions concentrations (or total emissions) and trends of: NO_X, SO_2, PM_{10}, $PM_{2.5}$ (if available), CO, ozone;

- Information about emissions sources (location of stationary sources, emissions levels)
- Data on vehicles number (motor vehicles and passenger cars) and potentially the current emissions standards in place
- Cause-specific mortality rates (cardiopulmonary, lung cancer) - e.g., in adults 30+ years and cause specific illness rates (cases of chronic bronchitis in the country) .
- Some data on indoor air pollution in countries where this is an issue: population use of solid fuels for cooking (%); open stove or fire with no chimney or hood
- Population size in individual administrative districts [most recent year]
- If available at national/large cities level, concentration of (some of the following): Particulates (PM_{10}, or other), SO_2, CO, NMVOCs, O_3, NO_2, Pb
- If available at national/large cities level, a) hectarage of individual crops; b) surface area of exterior building materials

Naturally if an in-depth study on air pollution is to be carried out in future, the above list of data could usefully be complemented by other information.

Table 5.2. Health and demographic data useful for Air Quality assessment

Children	Percentage of population with age 18 and below
Asthmatics	Percentage of asthmatics in total population
Adults	Percentage of population with age above 18
baseline_mortality	all-cause death rate per person per year
Total	Total population
above_65_yrs	Percentage of population with age above 65
asthma_children	Percentage of asthmatics in children
asthma_adults	Percentage of asthmatics in adults
Male	Percentage of male population
Female	Percentage of female population

Step 2. Define the baseline in time period of interest (e.g. 2020)

In order to calculate the baseline emissions, the following data may be needed:

- Data on expected population size in 2020 in the individual administrative districts.
- Projected data in 2020, or any intermediate years (2012, 2015 etc.) on the pollutants listed above e.g. from the Co-operative Programme for Monitoring and Evaluation of the Long Range Transmission of Air Pollutants (EMEP).

Example:

- Assume baseline emissions increase in direct proportion to projected growth in GDP.
- Assume GDP growth rate of 3% annum 2008-2020 to give emissions multiplier of 1.43 (approximate).
- 50,000 tonnes multiplied by 1.43 = 71,300 tonnes

Summary of key data needs (see also data checklist in Annex VI):

- If possible, data on expected population size in 2020 in the individual administrative districts.
- If possible, projection data for 2020, or any intermediate years (2012, 2015, 2020 etc.) on the pollutants listed above e.g. from the Co-operative Programme for Monitoring and evaluation of the Long Range Transmission of Air Pollutants (EMEP).

Step 3. Target to be used (at reference point: 2020)

a. Define policy target

The percentage reductions of air pollutant emissions from the baseline should be specified according to the needs of the policy maker. A reduction rate of 50 per cent from baseline emissions has been assumed in similar assessments previously undertaken.

b. Define projected state of environment when policy target applied

The total emissions of the air pollutants considered are estimated under the policy scenario.

> ***Example:***
>
> Baseline emissions in 2020 = 71,300. Policy scenario = 50% of Baseline emissions.
>
> - Define policy multiplier = 1 – Policy reduction scenario = 1 – 0.5
> - Multiply baseline emissions by emissions multiplier = policy scenario emissions
>   i.e. 71,300 * 0.5 = 35,650 tons.

Step 4. Assess the environmental improvements and the benefits

Most of the benefits will have to be assessed in qualitative terms, some of them in quantitative terms and, if data allows, in monetary terms. An overview is provided in the following table and the possible methodology for each type of assessment is explained below.

Table 5.3. Overview of the possible scale of the assessment: qualitative, quantitative and monetary analysis of benefits

Benefits	***Qualitative***	***Quantitative***	***Monetary***
Health	*YES*	*YES*	*YES*
Environmental	*YES*	*NO*	*NO*
Economic	*YES*	*YES*	*YES*
Social	*YES*	*NO*	*NO*

Air: Qualitative assessment

Describe the benefits in qualitative terms. An overview of key generic benefits from improved air quality is provided in the table below. Through interviews and literature research the following should be further developed and tailored to the country/local specific situation.

Table 5.4 Overview of key benefits

Health benefits	The most important benefits are health benefits. These will accrue particularly in the communities where the present air quality imposes some health risks. E.g. adoption of Best Available Techniques (BAT) in industrial processes may lead to lower particulate levels and removal of lead piping should lead to lower long-term incidence of premature death in the urban population. Adoption of scrubbers in coal powered electricity generating plants will result in reductions in the incidence of respiratory disease proportional to the reduction in sulphates and nitrates.
Environmental benefits	Reductions in sulphates and nitrates will result in lower levels of ecosystem eutrophication and acidification across the country, as well as neighbouring countries.
Economic benefits	Improved respiratory health resulting from air quality gains should result in lower absentee costs as fewer days are taken off for these illnesses within the working population. A wide range of environmental technologies and new ‘cleaner’ primary inputs, are required to bring about cleaner production processes that will be needed to meet the air quality standards specified. These industries will benefit economically from increased sales and society will benefit from increased employment in these sectors. There may also be potential benefits derived from improved tourism in areas that were previously damaged by acid rain.
Social benefits	The social benefits of reduced pollution to air are myriad and relate to improvements to the quality of life (e.g. through reduced health effects), the increased amenity value of improved landscapes, nature and air quality (through reduced pollution pressure), and reduced damage to cultural heritage such as historic building surfaces in city centres.

Air: Quantitative and monetary assessment[20]

The environmental improvement is based on the reductions in adverse health, economic and environmental effects under the percentage reductions defined for the pollutants identified.

[20] This section of the method benefits from significant input from Philipp Preiss and Wolf Mueller at IER, Stuttgart, who also provided output from the ECOSENSE model.

The four categories of pollution impacts that can be quantified are:

Health benefits:

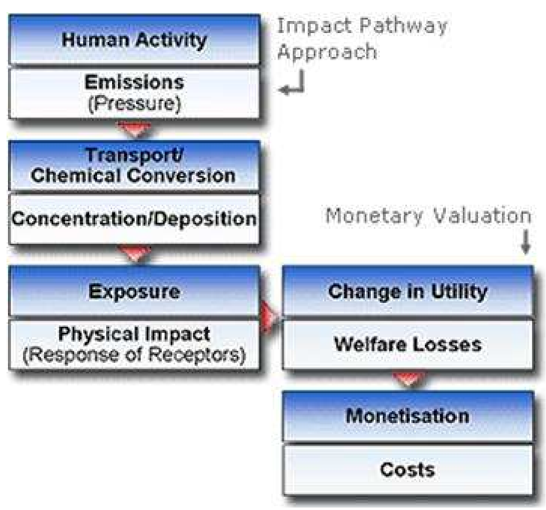
- Premature death avoided (mortality).
- Illness avoided (morbidity) – e.g. bronchitis[21], asthma.

Economic benefits:

- Crop damage avoided.
- Material damage avoided.

The quantitative and monetary assessment in the current project has been undertaken on the basis of the outputs of the ECOSENSE model - an integrated software tool which assesses these impact categories resulting from the exposure to airborne pollutants. In the current exercise, it includes the emissions of 'classical' pollutants SO_2, NO_x, primary particulates, NMVOC and NH_3. A full description of the model assumptions is included in a deliverable of the EC DG Research NEEDS project[22]. The modelling and the calculation of external costs follow the Impact Pathway Approach (IPA). The IPA, a bottom-up approach, is depicted in figure 5.1 below. The IPA starts with the emission of a pollutant at the location of the source into the environment, models its dispersion and chemical transformation in the different environmental media, identifies the exposure of the receptors and calculates the related impacts which then are aggregated to external costs.

Figure 5.1 Impact Pathway Approach (IPA)



The air quality model produces an output in terms of Euro per ton of pollutant. For the policy maker/analyst it is sufficient in initial analysis to use the existing estimates of Euro per ton of pollutant, as presented in Table 5.5. These range estimates and

[21] Benefits include the benefit to the individual of not incurring the illness, and also benefits of reduced hospitalisation days and reduced activity days.

[22] http://www.needs-project.org/RS1b/NEEDS_Rs1b_TP7.4.pdf

are derived from modelling undertaken in the ENPI countries or in countries judged to have similar conditions (population density, geography etc.). Of course, this transfer procedure introduces further uncertainty into the assessment. However, it is assumed that this uncertainty is captured in the use of a range of unit values.

These unit values should then be multiplied by the number of units (tons of pollutant) to give total monetary benefits of meeting the air quality target. The mean values are indicative only and should not be interpreted as being any more likely than either the lower or higher range values. For this reason, the analyst may choose to use the range values only.

Table 5.5 Air Quality Unit Values: Euro per ton of pollutant (2008 € PPP))

	NH_3	NMVOC	NO_X	PM10	SO_2
€/ton (mean)	8,400	30	4,700	32,400	9,500
€/ton (range)	2,210 - 24,000	280 - 710	1,900 - 11,600	8,300 - 78,600	3,300 - 14,600

Example:

- Baseline emissions in 2020 = 71,300.
- Policy scenario emissions in 2020 = 35,650.
- Baseline emissions minus Policy scenario emission = Change (reduction) in emissions
  i.e. 71,300 – 35,650 = 35,650
- Change in emissions of pollutant multiplied by unit value of pollutant = Total monetary benefits of emission reductions
  i.e. 35,650 * € 32,400 = € 1,155 million

Note that this example uses unit values of €1.1m and €0.2m for mortality and morbidity impacts, respectively.

The aggregate benefits can then be apportioned to the different impact categories, according to the outputs of the air quality model. Typical percentage splits are: mortality (70 per cent); morbidity (20 per cent); crops (6 per cent) and materials (4 per cent). In order to express the results in physical terms, the total benefits can be apportioned according to these splits and then divided by a unit value for the physical units. In the current context this is most meaningful for health.

Example:

- Total monetary benefits of emission reductions = €1,155 million
- Mortality benefits = 0.7 * €1,155m = €810 million
- Morbidity benefits = 0.2 * €1,155m = €230 million
- Mortality (premature deaths avoided) = €810 m/€1.1m = 735
- Morbidity (cases of chronic bronchitis-equivalents) = €230 m/€0.2m = 1,155

Note that this example uses unit values of €1.1 million and €0.2 million for mortality and morbidity impacts, respectively.

In addition to the overall benefits of air quality improvement, it is also important to consider potential trans-boundary effects resulting from transport of emissions between national territories. The difference in damages within or outside the country of relevance depends on the direction and strength of the wind as well as the size and the population density of the neighbouring country. For these countries a qualitative indication should ideally be given as to the likely importance of trans-boundary effects relative to domestic effects. Specifically, it should be possible to describe whether the combination of prevailing winds and location of urban centres, together with large industrial and energy production centres, is likely to lead to a significant proportion of total emissions affecting neighbouring countries. Additionally – as outlined in the Example box below – it should be possible to generate some indicative quantitative estimates of trans-boundary impacts, assuming specific proportions of these impacts in relation to total impacts.

Example:

- Total monetary benefits of emission reductions = € 1,155 million
- Assume a fixed proportion of total benefits is trans-boundary, e.g. 35% (typical in a number of ENPI countries)
- Total trans-boundary monetary benefits = € 1,155 million * 0.35 = € 405 million
- Total domestic monetary benefits = € 1,155 million * 0.65 = € 750 million

Note that this example uses the mean share.

Further aspects of the benefits assessment method.

The above sub-section outlines a simplified modelling procedure that can be used to estimate air quality benefits. This procedure makes use of the outputs from one integrated software model – EcoSense – such that the unit value output ranges simply have to be multiplied by the projected emission reductions under a given policy. Countries or cities wishing to do their own benefit assessment may wish to construct a model that replicates the different components of the EcoSense model, but which substitutes locally defined data into each component. This would include the following steps:

- Collect data on ambient air quality across major cities, ideally with zoning within cities.
- Collect data on what population are exposed to the ambient air pollution – e.g. residents, work areas, transport routes.
- Together this creates an exposure mapping for cities.
- Use dose-response functions to estimate probable risks of incidence of morbidity and premature mortality from air pollution – and how many people at risk affected. This will provide a quantitative assessment of the level of likely current incidence of morbidity and premature mortality. It can be useful to cross check with existing statistics on health impacts.
- Chose a target for ambient air quality improvement – e.g. a 50 per cent reduction in ambient concentrations of pollutants, or use a common standard for air quality that all parts of all cities should reach, and then calculate

changes in incidence levels. The change will give the quantitative assessment of the benefits of improved air quality.
- Use range of unit values to apply and calculate the value of avoided impacts.

The above could be done for a city, or indeed for all cities and town – depending on the ambitions of the analysis, the data and resources available. This type of approach has been carried out, for example, in the Ukraine (See Box below).

Box 5.1 Estimated VSL in Ukraine

An example of statistical value attributed to life in Ukraine is provided in the table below:

Table 5.6 Estimated VSL in Ukraine

	US $	€
Average VSL in high-income countries	2,000,000	2,634,755
Average GDP/capita in high-income countries	30,000	39,521
GDP per capita in Ukraine (2004)	1,360	1,792
Estimated VSL inUkraine	90,500	119,223

Source: Strukova,et al. 2006 – IEEP elaboration (exchange rate 12 March 2007: 1 USD = 0.759084 €)

6 METHODOLOGY FOR ASSESSING WATER RELATED BENEFITS

This part of the analysis covers the benefits deriving from improved water quality, both through improved infrastructure (drinking water and waste water network and treatment facilities) and through reduced pressures to natural water resources (rivers, lakes, coastal water etc.). This theme covers the following sub-themes and parameters:

- Sub-theme: Water - infrastructure and practice
    - Parameter: Connection to safe drinking water
    - Parameter: Connection to sewage network and hygiene conditions
    - Parameter: Level of waste water treatment

- Sub-theme: Water - natural resources
    - Parameter: Surface Water Quality
    - Parameter: Water Resource Scarcity

Water – infrastructure and practice – covers household drinking water quality, sewage, hygiene and waste water treatment. Questions that can be assessed pertain to the benefits arising from household connection to reliable and safe piped drinking water, connection to sewage networks, improved personal, domestic and community hygiene practices and treatment of waste water. Some of the benefits of waste water treatment relate to the health benefits associated with safe drinking water and improved surface water quality, which are assessed separately.

Water – natural resources - covers surface water quality and water resource scarcity. Surface water quality can be explored in terms of both freshwater/coastal waters and bathing waters. Assessment of water resource scarcity can involve identifying the long term benefits of maintaining and enhancing a stable source of water for domestic, agricultural, industrial and environmental uses.

Excel worksheets (Annex VII) are provided to support the calculations for the 'Level of waste water treatment' and the 'Water Resource Scarcity' parameters.

6.1 Sub-theme: WATER - INFRASTRUCTURE AND PRACTICE

This sub-theme encompasses the benefits from improving the infrastructure and practices related to water use, namely increased connectivity to piped drinking water supply and improved drinking water quality, increased connectivity to the sewage network, improved level of waste water treatment and improved hygiene conditions.

6.1.1 Connection to safe drinking water

<u>Definition of the parameter</u>

The parameter measures the number of people/households that are connected to a piped drinking water supply network and receive good quality drinking water from the tap.

The following definitions apply:

- *Population covered*: number of people (urban and rural) connected to piped drinking water supply network.
- *Minimum amount of water*: the amount of water needed to satisfy metabolic, hygienic and domestic requirements. This is usually defined as 20 litres of safe water per person per day (DESA, 2007).
- *Reliable piped water supply*: Continuous and plentiful water supply delivered at appropriate and constant pressure to household premises (yard/dwelling) through a piped water distribution network from a central water intake.
- *Safe drinking water*: Drinking water that does not contain biological, chemical or other agents at concentrations or levels considered detrimental to health according to WHO guidelines for drinking water quality.
- *Improved water sources*: Piped water to premises (dwelling/yard); public standpipes; tube wells/boreholes; protected dug wells and springs; and use of rainwater.
- *Unimproved water sources:* Unprotected dug wells and springs; tanker trucks/vendors; and open surface water sources (rivers, ponds, etc.).

<u>Unit of measurement (indicator):</u> number of people/households receiving good quality drinking water at tap.

<u>Rationale for choice:</u> Reliable and continuous provision of good quality drinking water is insufficient in many areas/countries. Problems with piped water distribution systems (leakages, contamination, large water losses etc.) can be an issue, both in urban and in rural areas. Piped water supply to premises (yard/dwelling), together with connection to a sewage network, are seen in most countries as the best opportunity to provide households with reliable and safe drinking water and ensure safe and hygienic removal of human excreta and other waste water pollutants from

the household and community environment. Piped water supply from a central water intake and distribution outlet allows for treatment of water and monitoring of water quality. If source water is generally of good quality and the piped distribution networks are well-functioning, such a water supply system has the potential to provide safe drinking water with minimal risk of disease (see also health implication related to sewage and hygiene in chapter 7.1.2). Therefore an improvement in the quality and availability of drinking water, both through improved treatment and infrastructures, is expected to deliver substantial benefits to the population, especially in terms of health and social wellbeing. It can also enhance consumer confidence on the security/quality of supply. Health benefits are assessed together with sewage connection and hygiene benefits, as these are common to the two parameters.

In the context of this study, 80-100 per cent of households in the ENPI countries have what is classified as access to an improved water source for drinking and other uses of water. However, a much smaller percentage of households – ranging from 40-90 per cent in the majority of the countries – have piped water supply on premises (WHO/UNICEF, 2010). The focus of the methodology in this section was therefore on household connection to reliable and safe piped drinking water supply on premises and not on upgrading from unimproved drinking water sources to other improved sources.

<u>Methodological steps</u>

The methodological steps are described in detail below. It should be noted that the calculation of the health benefits should be done jointly with the parameter on sewage connection and hygiene – see chapter 7.1.2. Additional information is also provided in Annex IV.

Data needed: see data checklist in Annex VI.

Step 1. Describe the state of the environment (at reference point: e.g. 2008 and/or most recent year available)

Describe the current state of household connection rates to piped drinking water supply and drinking water quality. In particular, provide a brief overview of:

- Percentage and size of population connected to piped water supply (distinguishing between rural and urban if data available).
- Share/size of population having access to pre-treated piped water (municipal treatment) with good quality at tap.
- Share/size of population with access to piped water but low quality at tap (of these, if possible, indicate share of those applying own water treatment e.g. boiling water, as this reduces risk of disease).
- Share/number of people who are not connected to piped water supply at all; if possible specify how water is supplied and the level of water quality.

- Information on the level of drinking water quality at tap – either based on qualitative information or, if monitoring is in place, on the level of compliance with WHO guidelines or with national chemical/microbiological criteria (please describe level of monitoring and which criteria are used).
- If possible, some information on water quantity (to set the scene and identify possible issues), such as amount of piped water, daily consumption per capita and/or issues related water supply interruptions.

Geographical coverage: Preferably national level, or regional level if data are not available. Local examples (e.g. a city) can be used to further illustrate the case, if relevant.

Summary of key data needs (see also data checklist in Annex VI):

- General/qualitative insights of state of quality of drinking water, key issues and opportunities for quality improvement
- (If available at national/large cities level) concentration of (some of the following): lead, pesticides, nitrates, mercury, sodium, chlorides, Escherichia coli (or faecal streptococci), total coliform in drinking water
- Piped water supply interruptions (frequencies and durations)
- Piped drinking water charges: number of households charged for water supply; average water charges and/or total revenues from charges
- Population size [most recent year]
- Population connected to piped water supply; total, urban, rural
- Population with improved water supply (piped, non-piped water supply) – total, urban and rural
- Households practicing appropriate point-of-use treatment of drinking water
- Households not practicing treatment of drinking water

Step 2. Define the baseline in time period of interest (e.g. 2020)

For ease of calculation on the health benefits, the baseline should be assessed jointly for the drinking water and sewage connection/hygiene parameters.

See chapter 7.1.2 for the joint methodology.

Step 3. Target to be used

Specifying clear targets to be reached by a certain year is an essential part of a benefit assessment. The targets can reflect goals laid out in sector or national strategies, or be scenarios for consideration when developing strategies. Drinking water targets used in the present studies are as follow:

- 100 per cent connection (except isolated rural areas) to piped drinking water and all piped water supply is properly treated, providing good quality water at household tap (water meeting WHO guidelines or, if information not available, water considered safe by national authorities).

Rationale: 100 per cent connection to good quality drinking water helps reduce the spread of water borne diseases and improves quality of life.

Other possible targets can be:

- Ensuring that the population which currently has a piped water supply continuously receives reliable and safe water at household premises.
- Providing plentiful and equally safe drinking water from other improved water sources in isolated rural areas.

Step 4. Assess the environmental improvements

The environmental improvement is the increase in population/households connected to safe drinking water if a target of 100 per cent connection to safe drinking water were to be achieved.

For ease of calculation on the health benefits, the environmental improvements should be assessed jointly for the drinking water and sewage connection/hygiene parameters.

See chapter 7.1.2 for the joint methodology.

Step 5. Assess the benefits

Many of the benefits from reaching the targets for the three parameters will often have to be assessed in qualitative terms while some of them can be assessed in quantitative and monetary terms. Which benefits can be assessed in quantitative and monetary terms will depend on data availability. An overview is provided in table 6.1 below.

Table 6.1. Overview of the scale of the assessment: qualitative, quantitative and monetary analysis of benefits

Benefits	*Qualitative*	*Quantitative*	*Monetary*
Health	*YES**	*YES (under 'sewage connection')*	*YES (under 'sewage connection')*
Environmental	*YES*	*NO*	*NO*
Economic	*YES*	*NO*	*NO*
Social	*YES*	*NO*	*NO*

**care needs to be taken regarding overlaps with sewage*

Qualitative assessment

Describe the benefits in qualitative terms. An overview of key benefits from improved connection to safe drinking water quality is provided in the table below. Through interviews and literature research, the following should be further developed and tailored to the country specific or local situation.

Table 6.2. Overview of key benefits

Health benefits	The most important benefits are health benefits. As these accrue jointly with improved sewage and sanitation, they are described in the next chapter 7.1.2.
Environmental benefits	An improvement of drinking water connection and quality does not lead to direct environmental benefits, but some benefits to habitats and water resources may accrue if water suppliers seek improvements in abstraction sources, such as enhanced protection and, where necessary, investment in ecological restoration.
Economic benefits	Piped water connection with reliable and continuous good quality water reduces/eliminates the need for household water storage tanks and reduces the time and money spent on household point-of-use treatment/ disinfection of water prior to drinking, or on purchase of bottled water. Good quality piped drinking water also reduces public and private health care expenditure and improves labour productivity and reduces work absenteeism. Access to good quality water can also provide cost savings to industries and make them more competitive, especially those relating to the food and beverage processing. Rehabilitation of existing piped water distribution networks (to improve water quality) reduces water losses and thus costs of providing potable water.
Social benefits	The provision of safe drinking water is viewed by many to be a basic human right. Where this is unavailable, communities may feel ignored by wider society, or the political leaders supposed to represent their needs and interests. This is undesirable in any country and the improvement of drinking water is an opportunity to provide a benefit to individuals directly. Piped water connection with reliable and continuous good quality water supply therefore provides increased convenience from having potable water available at premises. Access to good quality piped water also improves the public's perceptions of utilities and the state providing good quality services.

Quantitative assessment

The quantification of health benefits is carried out jointly with the sewage and hygiene parameter.

See chapter 7.1.2 for the joint methodology.

Monetary assessment

The quantification of health benefits is carried out jointly with the sewage and hygiene parameter.

See chapter 7.1.2 for the joint methodology.

The monetary assessment of the benefits of drinking water can also involve the use of willingness to pay (WTP) estimates for 'clean' drinking water. This has not been done in the present study to avoid double counting, as we considered that most of the benefits for drinking water quality were already captured in the joint assessment with sewage connection and hygiene.

However, should future studies intend to focus on drinking water only and/or carry out a comparative assessment using WTP values, we include below some additional information on the WTP approach.

WTP values are generally assumed to take into account both social and health benefits, and some overlaps may exist with the health benefits estimates under the 'sewage connection' parameter, as well as with other benefits under the 'surface water' parameter. For this reason a separate WTP assessment of drinking water was not carried out in this study. Future benefits assessments may wish to apply this approach, where reliable WTP values specific to drinking water become available so as to help allow cross comparison of results from different methods, which can help fine tune analyses.

This methodology requires a value to be attributed to the increase in the number of people that stand to benefit from the achievement of a 100 per cent connection to safe drinking water, by multiplying these additional people by a WTP value. In practice, the benefits will relate to both new accesses to supply and to availability of improved drinking water to people already connected.

Where the existing WTP exercises look at quality improvements only, it may thus be unnecessary to distinguish between the population having access to public water supply and those that will gain new access. Indeed, the WTP transfer value that will be used is based on quality improvements rather than new connections.

While it is clear that regarding all currently and newly connected households as beneficiaries could slightly overestimate the benefits, as some households with existing connection have good quality water, the choice of only focusing the analysis on those households that have new connections would likely lead to a much more significant underestimate.

Therefore, the WTP value should be applied to the sum of the population gaining access to the drinking water network **plus** the population moving from unsafe water to safe water quality – i.e. the total number of people with access to safe drinking water, as calculated under the environmental improvement. The following simple formulas can be applied:

Environmental improvement (BAU) X national adjusted WTP = million €/year

and/or

Environmental improvement (ref point) X national adjusted WTP = million €/year

Several WTP values on water are available from the existing literature, and more may become available in the future. A selection of existing values is provided below:

Table 6.3 Review of water-related valuation studies used in the benefit assessment

Study	Location	Effect valued	Values
Edwards (1988)	Cape Cod, Massachusetts, USA	WTP for provision of potable groundwater for personal use and use by future generations which is treated to the government health safety limits.	€ 619.7 – 3,090.4 / household / year
Hanley (1989)	East Anglia, UK	WTP to benefit from a guaranteed reduction in the nitrate levels of the drinking water supplies to 50mg/l.	€ 25.2 / household / year
Jordan and Edwards (1993)	USA	WTP to guarantee clean drinking water from groundwater sources.	€ 845 – 1,135.7 / household / year
Chowdhury (1999)	*Dhaka Slum*	Uses contingent valuation method to estimate Dhaka Slum-dwellers willingness to pay for safe drinking water; monthly average WTP for water was found to be Tk 82.62 per household	Tk 82.62 per household
Whittington, D. et al. (2002)	*Kathmandu, Nepal*	Almost 70% of the households who are connected to the network are willing to pay a monthly bill of US$ 8.33 for improved services (...) Among households who are currently not connected to the network, almost 50% are willing to pay a monthly bill of US$ 6.94 for similar services (i.e. '500 l of water a day that is risk free').	monthly bill of US$ 8.33
Casey et al. (2005)	*Manaus, Amazonas, Brazil*:	Residents are willing to pay (WTP) more than US$ 6.12 per month *for improved water services.*	US$ 6.12 per month.
Hua Wanget al. (2008)	*Chongqin (China),*	The willingness to pay for improved water service is low—between Yuan 2.5 to 3.3 /m^3 on average, or 1.5 to 2% of income—but is significantly higher than the current price, which is about Yuan 2.2 /m^3 on average.	between Yuan 2.5 to 3.3 /m^3 on average
Vasquez et al. (2009)	*Parral, Mexico*	Households are willing to pay from 1.8% to 7.55% of reported household income above their current water bill for safe and reliable drinking water services	7.55% of household income
Beaumais et al. (2010)	10 OECD countries	The median willingness to pay for better tap water quality in Mexico, Korea and Italy was estimated at 10.1%, 6.4% and 8.8% of the median water bill.	10.1%, 6.4% and 8.8% of the median water bill.

Countries wishing to explore the benefits of improved connection and water quality could use a range of approaches:

- one based on adopting a higher and lower value of WTP to access to quality water;
- another based on cost of illness (COI);
- and a third based on applying a benefits production function and transferring it to the conditions of the country.

For the first approach, the steps are:

- Identify the number of people/households that currently have access to water supply
- Ideally identify also the share of households for which this water supply is at appropriate quality standard.
- Develop a target for appropriate connection levels and quality levels by a given date – eg 100% per cent by 2020 for a comprehensive target that is ambitious for some but feasible for other ENPI countries.
- Comparing the current connection and quality level with the target level will give the number of people/households that will benefit from improvements.
- Choose a relevant upper and lower WTP – which can either be on a per capita or household basis. It can either be on a specific unit value (e.g. €/capita) or as a share of income – what is best depends on what base data is available. And apply to the shares of people/households with additional connection to good quality drinking water, taken due account of the demographic baseline and income changes. This will give the monetary value for the benefits of improved access to safe drinking water.

Depending on the nature of the WTP value used, this approach can either be complemented by a cost of illness (avoided) approach.

The COI approach instead involves estimating the cost of medical treatment (for cases that are treated) and the value of time lost to disease (such as time spent on treatment and lost work and leisure time). In practice the WTP will pick up many of the expected benefits of the COI approach but go further, so a comparison should lead to the WTP approach giving a higher number than the COI. However, the use of VSL can also lead to a higher value where there are certain illnesses that can lead to early mortality. Care is therefore needed in comparing estimates and understanding the factors driving the benefits.

Finally the benefits production function approach can be seen as a type of sophisticated WTP approach, where a range of WTP studies are combined in a meta-analysis to assess the underlying drivers of benefits and then transferred to the country doing the assessment. The key here is to find a benefit production function that can be suitably 'transferred' from the country/countries of origin to the study country concerned.

6.1.2 Connection to sewage network and hygiene conditions

<u>Definition of the parameter</u>

The parameter measures the number of people served by collecting systems to conventional public sewers (or with improved sanitation is isolated rural areas) and addresses household and personal hygiene conditions.

The following definitions apply:

- *Plentiful water:* The amount of water needed to satisfy metabolic, hygienic and domestic requirements. This is usually defined as a minimum of 20 litres of water per person per day (DESA, 2007).
- *Sanitation:* Here defined as systems, facilities, and practices for disposal and removal of human excreta (urine and faeces). Sanitation systems include sewage networks, septic tanks and pits and waste water treatment. Sanitation facilities include various types of toilets, and sanitation practices include practices such as open defecation.
- *Improved sanitation:* Flush/pour-flush toilets to sewage networks, septic tanks or pits; ventilated improved pit toilets (VIP); and pit toilets with slab.
- *Unimproved sanitation:* Pit toilets without slab; hanging toilets over water; bucket toilets; and open defecation (no access to a toilet facility). Households sharing toilets with other households are also classified as having unimproved sanitation, regardless of type of toilet.
- *Sewage:* Waste water from households (and industry and other sectors) which is collected and carried off in a sewage network. Sewage generally contains human excreta and water and may also contain other wastes (e.g. kitchen and washing waste).
- *Sewage network:* A closed system of sewage pipes used to carry off sewage and drainage water. Improved toilets connected to a sewage network are classified as improved sanitation and is often considered as the most developed stage on the sanitation ladder.
- *Hygiene:* A procedure or system of procedures or activities used to reduce microbial contamination on environmental sites and surfaces and the external body in order to prevent the transmission of infectious disease (IFH, 2001).

<u>Unit of measurement (indicator):</u>

- Number of people/share of population connected to the sewage network.
- Number of people/share of population with improved sanitation (isolated rural areas).

<u>Rationale for choice:</u> Inadequate household water quality and quantity, sanitation and hygiene practices are globally associated with substantial health effects. The largest health burden is diarrheal disease and mortality. A much smaller number of cases of other diseases (typhoid, Hepatitis etc.), albeit more serious, adds to this

burden, as does health effects from drinking water contaminated by chemicals and heavy metals. Repeated diarrheal infections in early childhood can also contribute to poor nutritional status in children. Indicators of poor nutritional status include prevalence of underweight children under the age of five. Child malnourishment is associated with a substantial increase in the risk of mortality from infectious disease (e.g. diarrhoea, respiratory infections, measles, malaria and other infectious diseases). Child stunting is associated with impaired cognitive development, school performance, and lifetime earnings (Fishman et al., 2004). While prevalence rates of underweight children and stunting are generally lower in the ENPI countries than in many other parts of the world, accounting for the effects of repeated diarrheal infections on child nutritional status and consequent increase in child mortality is included in the benefit assessment methodology in this section along the lines of World Bank (2008a) and Fewtrell et al. (2007).

Piped water supply to premises (yard/dwelling) and connection to a sewage network are seen in most countries as the best opportunity to provide households with reliable and safe drinking water and ensure safe and hygienic removal of human excreta and other waste water pollutants from the household and community environment. Connection to a sewage network provides the added opportunity of minimizing pollution of water and land resources through central treatment of waste water.

Good hygiene practices are also of utmost important for disease prevention. The single most important hygiene practice is hand washing with soap at critical junctures (after defecation/going to toilet or cleaning child faeces, before cooking and eating, and before feeding a child). Hand washing with soap is found in many countries to reduce incidence of diarrhoea by as much as 45 per cent (Curtis and Cairncross, 2003; Fewtrell et al., 2005). Good hand washing practices are also found to reduce transmission of respiratory infections (Luby et al., 2005; Rabie and Curtis 2006). Status of hygiene practices is generally not available in most countries unless detailed studies/surveys have been undertaken. What is clear, however, is that improvements in hygiene practices can be achieved in most countries, which will help reduce risk of diarrheal disease as well as respiratory infections.

In the context of this study, 70-100 per cent of households in the ENPI countries have what is classified as improved sanitation facilities (WHO/UNICEF, 2010), while 30-75 per cent of households in almost all the countries are connected to a sewage network. The focus of the methodology in this section was therefore on household connection to sewage network.

Methodological steps

The methodological steps are described in detail below. As noted above, the calculation of the health benefits is done jointly with the parameter on the connection to safe drinking water. Additional information on this is also provided in Annex IV.

Data needed: see data checklist in Annex VI.

Step 1. Describe the state of the environment (at reference point: e.g. 2008 and/or most recent year available)

Describe the current state of household connection rates to sewage networks and use of septic tanks (isolated rural areas). In particular, provide a brief overview of:

- General insights on the overall level of sanitation (to set the scene).
- Percentage and size of population connected to sewage networks.
- Percentage and size of population with improved sanitation (notably using septic tanks).
- Percentage and size of population not connected to the sewage and not using septic tanks (residual from the above), describing the type of alternative measures taken (if any), and the reason for the lack of use of sewage or improved sanitation.

Describe the current state of hygiene practices at the household and community levels. In particular, provide a brief overview of:

- Hand washing practices from any available household, schools and day cares and community surveys.
- Domestic hygiene conditions from any available household surveys.
- Hygiene related sanitation practices and conditions at household and community levels (cleanliness of toilet facilities etc.).

Geographical coverage: Preferably national level, or regional level if data are not available; local examples (e.g. a city) can be used to further illustrate the case, if relevant.

Summary of key data needs (see also data checklist in Annex VI):

- General/qualitative insights of state of sewage connection and improved sanitation, key issues and opportunities for improvement
- Information on water borne diseases, such as diarrheal disease rate in population above 5 years of age and other illnesses and cases of mortality in all age groups (e.g. incidence of typhoid, incidence of health outcomes associated with heavy metals, pesticides, nitrates and fluorides etc.)
- Average industrial/domestic waste water charges and/or total revenues from charges
- Population size [most recent year]
- Population connected to the sewage network
- Population with improved sanitation facility
- Population with no connection to the sewage network (residual from above)
- Data on the occurrence of water related illness and mortality among children under five years of age: diarrheal mortality rate; two-week prevalence of diarrheal disease (and estimated annual diarrheal disease rate)

It should be noted that:

- The JMP provides 2008 data on population with piped water supply, other improved and unimproved water supply, population connected to sewage, population with other improved and unimproved sanitation and population practicing open defecation for almost all ENPI countries.
- Recent DHS and MICS surveys (2005-2008) are available for most ENPI countries. However, not all the country surveys contain data on household treatment of drinking water. Most of the surveys provide data on diarrheal prevalence in children under five years.
- WHO has recently provided new estimates of cause-specific structure of child mortality for 2008 in each member states (includes all ENPI countries except West Bank and Gaza). UNICEF reports prevalence of underweight children under the age of five from DHS, MICS and nutrition surveys for most of the countries.

Step 2. Define the baseline in time period of interest (e.g. 2020)

The baseline is assessed jointly for drinking water and sewage/hygiene.

To estimate the number of beneficiaries and the benefits of achieving targets for improvements in the two parameters, the targets are compared to the percentage of the population anticipated to have piped water supply on premises, connection to a sewage network system and good hygiene practices adequate for health protection in the target year (e.g., 2020) if no efforts were undertaken to reach the targets.

Status of hygiene practices may not be well known, so a value between 0 to 100 per cent can be applied to reflect the level knowledge available about hygiene practices. The most simplistic BAU baseline would be to assume that connection rates and hygiene practices in the target year (e.g. 2020) are the same as in the reference year (e.g. 2008). Other data for 2020 are also needed to establish the baseline for benefit assessment:

- Population and average household size
- Crude birth rates
- Diarrheal incidence rates
- Diarrheal mortality rates
- Child mortality rates from infectious diseases
- Child nutritional status (prevalence of underweight children < 5 years of age)

These data need to be estimated and should reflect the baseline assumptions about piped water and sewage connection rates and hygiene practices.

Step 3. Target to be used

Possible targets are:

Sewage connection:

a) Achieving 100 per cent population connection (except in isolated rural areas) to a sewage network system.
b) Upgrading to flush toilet (with sewage connection) for households with dry toilet or no toilet.
c) Providing improved sanitation to households currently without such facilities in isolated rural areas.

Hygiene:

Improving hygiene practices especially ensuring good hand-washing with soap at critical junctures wherever such practices are currently inadequate for protection of health.

Rationale: reaching the target will have major benefits from improved sanitation/hygiene in households, improving quality of life and reducing the spread of water-borne diseases. Improved sewage collection will also enable better waste water treatment (by reducing the direct run off of untreated sewage in the natural environment), therefore helping improve surface and coastal water quality. These latter aspects will be addressed under other parameters (waste water treatment, bathing water quality and freshwater quality) in order to avoid repetition.

Step 4. Assess the environmental improvements

The environmental improvements are assessed jointly for drinking water and sewage/hygiene.

The improvements from reaching the targets (e.g. by 2020) are the difference between the specified targets and the baseline assumptions i.e. the increase in population or households connected to safe drinking water and sewage networks, and that practice good hygiene adequate for health protection, as illustrated in table 6.4 below.

Table 6.4 Number of beneficiaries of reaching the targets

	Number of people (million)	Number of households (million)
Reliable and safe piped water supply to premises		
Improvement in reliability and quality of water among those currently with piped water supply		
Connection to sewage network		
Improved hygiene practices		

Step 5. Assess the benefits

Most of the benefits will have to be assessed in qualitative terms, some of them in quantitative term and, if data allows, in monetary terms. An overview is provided in table 6.5 and the methodology for each type of assessment is explained below.

Table 6.5. Overview of the scale of the assessment: qualitative, quantitative and monetary analysis of benefits

Benefits	*Qualitative*	*Quantitative*	*Monetary*
Health	*YES*	*YES*	*YES*
Environmental	*YES (under WWT)*	*NO*	*NO*
Economic	*YES (under WWT)*	*NO*	*NO*
Social	*YES*	*NO*	*NO*

Qualitative assessment

Describe the benefits in qualitative terms. An overview of key benefits from improved connection to sewage network/septic tanks is provided in table 6.6 below. Through interviews and literature research, the following should be further developed and tailored to the country/local specific situation.

Table 6.6. Overview of key benefits:

Health benefits	Hygienic sanitation (flush toilets connected to sewage network) and good hygiene practices, together with good quality piped water supply, reduce the presence and transmission of pathogens, thus reducing the incidence of diarrhoea and other diseases (Fewtrell et al., 2005). Reduced incidence of diarrhoea in early childhood contributes to improved nutritional status among children (World Bank, 2008a). Good hygiene practices (especially regular hand washing with soap) also reduce transmission of respiratory infections (Luby et al., 2005; Rabie and Curtis, 2006). Reduced contamination of drinking water sources with chemical, heavy metal and other toxic substances reduces the incidence of associated diseases and health disorders.
Environmental benefits	Sewage collection provides opportunity for proper treatment of waste water which helps improve environmental quality including cleaner communities, cleaner urban and rural waterways (e.g. canals), cleaner rivers, lakes and coastal waters and reduced pollution of land resources (see chapter 7.1.3 on Waste water Treatment and 7.2.1.on Surface Water Quality).
Economic benefits	The environmental benefits (see above) of sewage collection and proper treatment of waste water can provide substantial recreational, tourism and fishery benefits. Good treatment of waste water can also allow for waste water reuse in agriculture and provide substantial cost savings in mobilizing and treating potable water, especially important in water scarce countries (see section on Water Scarcity).
Social benefits	Sewage connection (and hygienic toilet on premises for those currently without it) increases household convenience (no needs for emptying and maintaining sewage pits/septic tanks; reduced access time to toilet facility or place of defecation). It also reduces odours and nuisance by preventing direct sewage discharge into the local environment.

Quantitative assessment

- **Health benefits**

The steps in a quantitative assessment of health benefits of reaching the targets for the two parameters (drinking water and sewage/hygiene) are illustrated below. The focus is on the following benefits:

– reduced incidence of diarrheal disease;
– reduced mortality from diarrheal disease; and
– reduced mortality from infectious diseases associated with improved nutritional status in young children from reduced incidence of diarrhoea.

Expected reduction in annual incidence of diarrheal disease and diarrheal mortality by reaching the targets is presented in the table below by population group in relation to their current status of water supply, sanitation (i.e. sewage connection) and hygiene practices. These rates of reduction can be modified based on more detailed analysis of available data in a country. Among young children, the diarrheal disease reductions are expected to somewhat improve their nutritional status and thus reduce the risk of fatality from infectious diseases.[23]

Some clarification of these expected disease and mortality reductions are warranted. While groups 1-2 currently have piped drinking water supply, some households are likely to have sub-optimal water quality when connected to old, leaky networks and/or networks with fluctuating pressure and irregular continuity of supply, as water will be susceptible to contamination along the water distribution network even if water is well treated at central treatment plants. A 15 per cent reduction in diarrheal disease and mortality is therefore expected on average for these population groups from improvement in reliability and quality piped water (this can be modified based on country specific situations). For population groups 3-4, which currently do not have piped water supply, a 25 per cent reduction in disease and mortality is expected from receiving reliable and safe piped water supply to premises and in greater quantities than from their current water sources. Connection to sewage network (and flush toilets for those currently without such toilets) for groups 2 and 4 reduces the risk of pathogen transmission and is expected to reduce disease and mortality by an incremental 20 per cent. If there also is substantial scope for improvement in hygiene practices among any of these population groups, disease and mortality reduction is expected to be an additional 30 per cent.[24]

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[23] See World Bank (2008) for a discussion and quantitative assessment of the nutritional impacts and associated health outcomes of repeated diarrheal infections in young children.

[24] The expected diarrheal disease and mortality reductions are based on adaptations of findings reported in Arnold and Colford (2007), Clasen et al (2007), Fewtrell et al (2005), and Curtis and Cairncross (2003).

Table 6.7 Expected diarrheal disease and diarrheal mortality reduction from reaching the targets by population group

				Expected average reduction in diarrheal disease and mortality	
Groups	***Current water supply and sanitation coverage***	***Population distribution (Baseline in target year)***	***Water and sanitation improvement***	***Already good hygiene***	***Substantial scope for hygiene improvement***
1	Piped water supply and sewage connection		Improvement in reliability and quality of piped water (so as to ensure plentiful and safe water supply) for those of this population currently having water reliability and quality problems	15%	45%
2	Piped water supply but no sewage connection		a) Improvement in reliability and quality of piped water (so as to ensure plentiful and safe water supply) for those of this population currently having water reliability and quality problems. b) Sewage connection (and flush toilet for those with dry toilet or no toilet) for all of this population.	35%	65%
3	Not piped water supply but sewage connection		Reliable and safe piped water supply to premises for all of this population	25%	55%
4	Not piped water supply and no sewage connection		Reliable and safe piped water supply and sewage connection (and flush toilet for those with dry toilet or no toilet) for all of this population	45%	75%
	National total	**100%**			

Source: Authors

Based on the baseline distribution of population water and sanitation coverage (and assumptions about hygiene practices) in the target year, the nationwide reduction in cases of diarrheal disease and mortality can be estimated by applying the methodology in Annex IV.

Monetary assessment

The monetised benefits of the reduction in cases of diarrheal disease and mortality can be estimated by applying unit values to each case of diarrheal disease and mortality. For disease, two techniques are generally available to estimate such unit values - the cost-of-illness (COI) approach and individuals' willingness-to-pay (WTP) for a reduced risk of disease or for avoiding a case of disease. As noted above, the COI approach involves estimating the cost of medical treatment (for cases that are treated) and the value of time lost to disease (such as time spent on treatment and lost work and leisure time). Valuation of time losses is usually based on market wage rates, or a fraction of these wage rates. WTP can either be estimated from studies in the country or, if not available, through benefit transfer approach from studies in other countries.

For mortality, two techniques are also available to estimate unit values - the human capital approach (HCA) and individuals' WTP for mortality risk reduction (which is converted to a value of statistical life (VSL)). The HCA estimates the human capital value (HCV) of an individual as the present value of future income that is lost from premature mortality. The more common approach nowadays, however, is the use of VSL. A benefit transfer approach can be used to estimate the VSL if no WTP studies have been conducted in the country (see Annex II on benefit transfer).

For this project, the VSL approach was adopted. The cases of disease of mortality have been multiplied by the estimated value of statistical life (VSL) in ENPI countries given in Table 4.7, chapter 4.5.2.

6.1.3 Level of waste water treatment

<u>Definition of the parameter</u>

The parameter measures the number of people connected to a waste water treatment facility of at least biological (secondary) grade.

The following definitions apply:

- *Urban waste water:* domestic waste water or the mixture of domestic waste water with industrial waste water and/or run-off rain water. (CEC, 1991)
- *Domestic waste water:* waste water from residential settlements and services which originates predominantly from the human metabolism and from household activities. (CEC, 1991)
- *Industrial waste water:* any waste water which is discharged from premises used for carrying out any trade or industry, other than domestic waste water and run-off rain water. (CEC, 1991)
- *Waste water treatment:* any process that reduces the amount of the suspended solids and dissolved compounds and micro-organisms harmful to the environment and/or the human health in waste water. Only treatment in facilities operating with the approval of environmental and/or health authorities should be considered. (WHO 2002)
- *1 Population Equivalent (PE):* the organic biodegradable load having a five-day biochemical oxygen demand (BOD_5) of 60 g of oxygen per day. (CEC, 1991). For the purpose of this study, if no data on PE is available, just assume that 1 PE= 1 inhabitant.
- *Primary treatment:* treatment of urban waste water by a physical and/or chemical process involving settlement of suspended solids, or other processes in which the BOD_5 of the incoming waste water is reduced by at least 20 % before discharge and the total suspended solids of the incoming waste water are reduced by at least 50 %. (CEC, 1991)

- *Secondary treatment:* treatment of urban waste water by a process generally involving biological treatment with a secondary settlement or other process. (CEC, 1991)
- *Tertiary treatment:* The process which removes pollutants not adequately removed by secondary treatment, particularly nitrogen and phosphorus; accomplished by means of sand filters, microstraining, or other methods. (EEA, undated)
- *Eutrophication:* the enrichment of water by nutrients, especially compounds of nitrogen and/or phosphorus, causing an accelerated growth of algae and higher forms of plant life to produce an undesirable disturbance to the balance of organisms present in the water and to the quality of the water concerned. (CEC, 1991)

Unit of measurement (indicator):

- Number of people connected to waste water plants with at least secondary treatment (i.e. secondary or tertiary treatment)

Rationale for choice: The level of waste water treatment if often rather poor and there is substantial room for improvement in many of the countries under study, or in parts of them. Poor waste water treatment leads to damage to the natural environment and can substantially affect water quality. Health impacts are covered under the parameter 'Connection to sewage network and hygiene conditions' (chapter 7.1.2).

Methodological steps

The methodological steps are described below. An Excel worksheet in Annex VII is provided to help carry out some of the calculations, which are also described below.

Data needed: see data checklist in Annex VI.

Step 1.Describe the state of the environment (at reference point: e.g. 2008 and/or most recent year available)

Describe the current state of waste water treatment. In particular, fill in the table below and provide a brief overview of:

- General insights on the overall level of waste water treatment and infrastructure, key issues and potential for improvements.
- Percentage and/or size of population connected to waste water treatment plants (distinguish between primary, secondary and tertiary treatment). If data are expressed also in Population Equivalent (PE)[25] please include. If there is tertiary treatment, please indicate where it is and whether this is for removal of phosphorus, nitrogen or for disinfection (or more than one of these).

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[25] Different definitions exist for PE, but usually it can be assumed that 1 PE accounts for a bit more than 1 inhabitant. The total number of settlements requiring at least secondary treatment therefore is likely be larger than those identified.

- Amount (m^3) of waste water undergoing primary, secondary and tertiary treatment.
- Total number and total capacity (m^3) of waste water treatment plants (distinguish between primary, secondary and tertiary treatment).
- If possible, briefly note where the plants are located (regions, big cities) – include a map if available.
- Insights on issues related to waste water discharges at sea or inland water e.g. issues of eutrophication, impact on tourism, impact on population wellbeing (e.g. odours) etc.
- Insights on areas where tertiary treatment are located.

Table 6.8. Waste water discharge and treatment [year]

	Total	Primary treatment (Mechanical treatment plants)			Secondary treatment	Tertiary treatment (if any)
		Sea outfall*	Inland water outfall*	Total		
Total waste water discharged (m3/day)						
# inhabitants connected to WWT plants**						
Total population***						
% connected over population						
Waste water treated (m3/day)						
% treated over total waste water discharged						
# WWT plants						
WWT plants total capacity (m3/day)						
PE treated (if available)						
PE total capacity (if available)						

* Distinguish between sea outfall and inland water outfall if possible, otherwise simply note total.
** Note this is likely to be lower that the # inhabitants connected to the sewage network, calculated in the previous chapter. This is because not all the waste water in the sewage network is treated in waste water treatment plants, as some may be discharged directly e.g. into water bodies. This is NOT to be included in this chapter.
*** If data allows, a distinction should be made between population in settlements above and below 2,000 people. The latter would not require treatment plants. Hence the population size here should refer only to the people living in settlements >2,000. These data may be difficult to obtain though, so a simpler approach will be to simply refer to total population in the country (although this may appear as a slight overestimate, it may actually be accurate enough as small villages will also arguably benefit from waste water treatment. Small villages could also share WWT plants)
Note: Clarify year of data on the table heading. Clarify source(s) of data

Geographical coverage: Preferably national level, or regional level if data are not available; local examples (e.g. a city) can be used to further illustrate the case, if relevant

Summary of key data needs (see also data checklist in Annex VI):

- Number of people connected to waste water treatment plants - distinguish between primary, secondary and tertiary treatment
- Amount of waste water undergoing primary, secondary and tertiary treatment (in m^3 and, if available, population equivalents)
- Installed capacities of water treatment plants (in m^3 and, if available, population equivalents) - distinguish between primary, secondary and tertiary treatment
- Amount of waste water released untreated into rivers, lakes and sea (m^3)
- Data on sewage loading (if available), namely on: amount of N-tot and P-tot in raw sewage per capita per day; discharge of N-tot and P-tot by wastewater treatments plants; discharge from households not connected (in towns with > 2,000 inhabitant equivalents)
- Waste water charges (if these exist): average rate of domestic discharging; average rate for industry discharges; total revenues from waste water charges. Note – make sure it is clear if these are the same or additional to sewage connection charges.
- Population living in settlements above 2,000 inhabitants, if available
- Waste water: produced volume
- Waste water: treated volume

Step 2.Define the baseline in time period of interest (e.g., 2020)

Estimate how many people will be connected to primary/secondary/tertiary waste water treatment in 2020 by using the share of population connected today (%) over projected population (in settlements above 2,000 inhabitants) in 2020.

To estimate projections of population living in settlements above 2,000 inhabitants, use the current share of such a population compared to the total population in the reference year (e.g. 2008), and the total population projections in the target year (e.g. 2020) – i.e. assume the share will remain unchanged in the future. An example of the calculations needed is shown below (numbers are illustrative).

Current population [2008]	Current population connected to primary treatment	Share of connected to primary treat. over current population	Current population connected to secondary treatment	Share of connected to secondary treat. over population	Current population connected to tertiary treatment	Share of connected to tertiary treat. over population
units	units	%	units	%	units	%
a	b	c=(b/a)*100	d	e= (d/a)*100	f	g=(f/a)*100
60,000,000	20,000,000	33.3%	15,000,000	25.0%	5,000,000	8.3%

If alternative or complementary data on volume of waste water treated are available, use these and assume the volume of waste water will increase proportionally to the population growth rate. An example of the calculations needed is shown below (numbers are illustrative).

Total volume of waste water discharged/day	Amount of WW under primary treatment	Share of primary treat over total	Amount of WW under secondary treatment	Share of secondary treat over total	Amount of WW under tertiary treatment	Share of tertiary treat over total	Amount of WW untreated	Share of untreated WW over total
m^3	m^3	%	m^3	%	m^3	%	m^3	%
h	i	j=(i/h)*100	k	l=(k/h)*100	m	m=(m/h)*100	o=h-i-k-m	p=(o/h)*100
4,000,000	1,500,000	37.5%	400,000	10.0%	100,000	2.5%	2,000,000	50.0%

If more accurate data exist in official statistics (e.g. estimates by settlement size, estimates on changes in rural population) these can be used instead of the above calculations.

Summary of key data needs (see also data checklist in Annex VI):

- Determine whether statistics on population by settlement size, and future projections, exist
- Data on expected population size in 2020

Step 3.Target to be used

- 100 per cent secondary treatment in urban areas and main rural areas (i.e. settlements above 2,000 inhabitants).

Rationale: 100 per cent secondary treatment is considered a realistic target, primary treatment being insufficient to address environmental concerns and tertiary treatment being likely too advanced/costly.

Step 4.Assess the environmental improvements

The environmental improvement is based on the increase in population connected to secondary waste water treatment if 100 per cent connection (of settlements above 2,000 inhabitants) were to be achieved. The calculations to assess the improvement are shown below (number are illustrative - note formulas refer also to baseline data calculated above).

Using data on population connection:

Population [2020]	Population increase rate	Estimated population connected to primary treatment in 2020	Estimated population connected to secondary treatment in 2020	Estimated population connected to tertiary treatment in 2020	Target	Env improvement [2020 values]	Env improvement (share)	Env improvement [2008 values]
units	%	units	units	units	unit	units	%	units
q	r	s=b*r	t=d*r	u=f*r	v=q	w=v-t-u	x=(w/q)*100	y=a-d-f
70,000,000	0.17	23,333,333	17,500,000	5,833,333	70,000,000	46,666,667	66.7%	40,000,000

Alternatively/additionally using data on volume of waste water treated (m^3):

Population increase rate	Estimated total volume WW in 2020	Estimated volume under primary treat in 2020	Estimated volume under secondary treat in 2020	Estimated volume under tertiary treat in 2020	Estimated volume untreated in 2020	Target	Env improvement = [2020 values]	Env improvement (share)	Env improvement [2008 values]
%	m^3	m^3	m^3	m^3	m^3	unit	m^3	%	m^3
r	Aa=h*r	Ab=i*r	Ac=k*r	Ad=m*r	Af=aa-ab-ac-ad	Aa	Ah=ag-ac-ad	Ai=(ah/aa)*100	Aj=h-k-m
0.17	4,666,667	1,750,000	466,667	116,667	2,333,333	4,666,667	4,083,333.3	87.5%	3,600,000

Step 5.Assess the benefits

Most of the benefits will have to be assessed in qualitative terms, some of them in quantitative term and, if data allows, in monetary terms. An overview is provided in the following table, and the methodology for each type of assessment is explained below.

Table 6.9. Overview of the scale of the assessment: qualitative, quantitative and monetary analysis of benefits

Benefits	***Qualitative***	***Quantitative***	***Monetary***
Health	*NO*	*NO*	*NO*
Environmental	*YES*	*NO (unless existing data)*	*NO*
Economic	*YES*	*NO*	*NO*
Social	*NO*	*NO*	*NO*

Qualitative assessment

Describe the benefits in qualitative terms. An overview of key benefits from improved waste water treatment is provided in the table below. Through interviews and literature research, the following should be further developed and tailored to the country/local specific situation.

Table 6.10. Overview of key benefits

Health benefits	Most health benefits are related to sewage collection, rather than treatment per se, as sewage that is not appropriately collected can cause significant health problems (such as diarrheal diseases, dysentery, Hepatitis, etc.). These benefits are therefore assessed under the 'sewage connection' parameter and not here, to avoid duplication (see chapter 7.1.2).
Environmental benefits	The increased and improved treatment of waste water is meant to lead to a reduction in nutrient discharges and therefore, a reduction in eutrophication in aquatic ecosystems, with due improvements to the eco-systems and associated recovery of fish and other aquatic life. It must be noted that nutrient removal does not just arise from tertiary treatment. Significant removal also occurs with secondary treatment. In countries where eutrophication represents an important ecologic problem, the environmental benefits can be significant.
Economic benefits	Many drinking water sources are derived from rivers, which receive waste water discharges. Therefore a reduction in contaminants in the abstracted waters can bring direct financial benefits in terms of reduced costs of treatment for potable water. Moreover it can be anticipated that, thanks to increased/improved water treatment, surface water should be more suitable for economic uses such as cooling water and industrial water. This will bring significant direct cost reductions to water intensive industries in particular. Furthermore, the investment in environmental technology and improvement in the skills of those working in the water industry will assist in enhancing the economic base of the country.
Social benefits	Most health benefits are related to sewage collection, rather than treatment per se, e.g. reduced nuisance related to odours from direct discharge of sewage in the environment etc. These benefits are therefore assessed under the 'sewage connection' parameter and not here, to avoid duplication.

Quantitative assessment

- **Environmental benefits**

If studies exist/are available, include information on potential reduction of pollutants from untreated waste water.

Monetary assessment

Not applicable, unless information readily available in existing literature (some of the benefits will be assessed under sewage connection and surface water quality).

6.2 Sub-theme: WATER - NATURAL RESOURCES

This parameter covers the benefits deriving from improving the state of natural water resources, namely, by addressing water quality and water scarcity.

6.2.1 Surface water quality

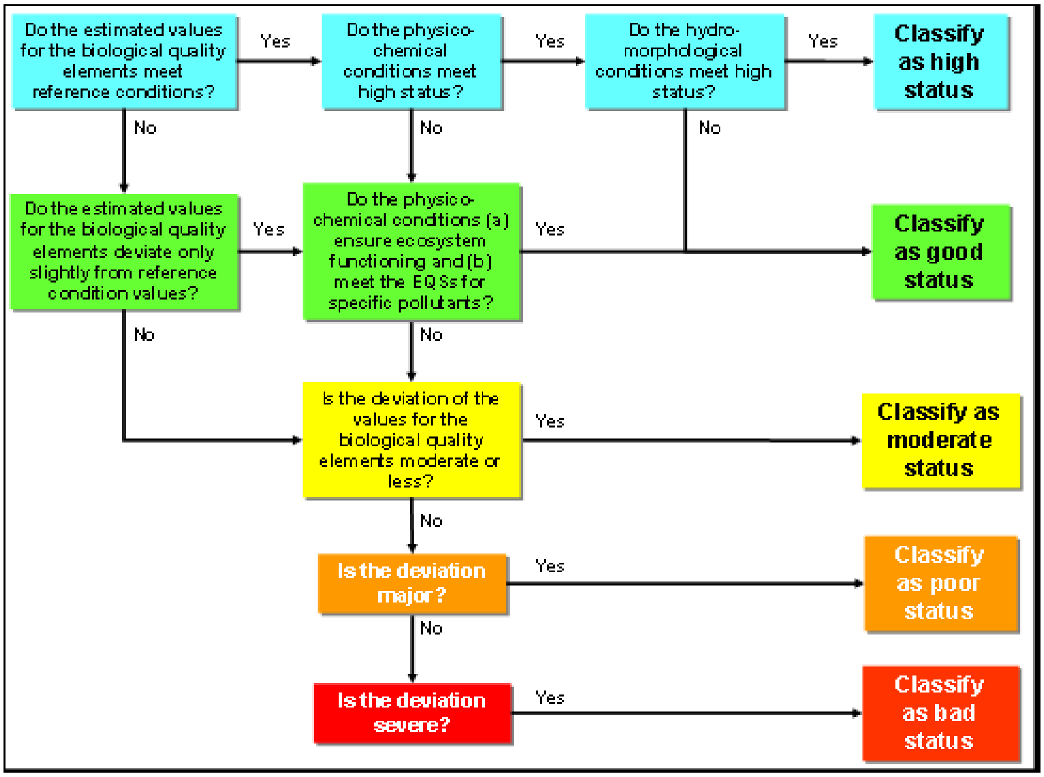
Definition of the parameter

The parameter measures the quality status of rivers, lakes, reservoirs, transitional and coastal waters (up to three nautical miles). Water quality status is divided into five categories depending on the biological elements present in the water. These categories build on the EU Water Framework Directive (WFD) (EC, 2000) quality status categories: bad, poor, moderate, good and high.

The following definitions apply for the quality status categories:

- *Ecological status:* The WFD requires that the overall ecological status of a water body be determined by the results for the biological or physicochemical quality element with the worst status (i.e. the quality element worst affected by human activity). This is called the 'one out - all out' principle: for all specific pollutants (which are a sub-set of the chemical and physicochemical quality elements), with the exception of ammonia, compliance with the environmental quality standards for good status will be consistent with classification as high or good ecological status. Whether high or good is assigned will depend on the condition of the other quality elements - see figure below.

Figure 6.1. Decision-tree illustrating the criteria determining the different ecological status classes



Source: UKTAG, 2008

Unit of measurement (indicators):

- % surface water in at least good status (this comprises the good plus high quality status categories)

Rationale for choice: Surface water quality is important in many countries due to the increasing level of pollution and the importance of aquatic ecosystems in pristine areas, including for recreation. Improving bathing water quality will protect those engaged in swimming in designated bathing waters from contaminants in the waters. Of particular concern are microbial contaminants, which may arise from inadequately treated waste water and run-off from agriculture. These contaminants can cause diseases, primarily gastrointestinal symptoms. The population groups that may be at higher risk of disease include the young, the elderly and tourists who do not have immunity against locally occurring endemic diseases. Children tend to play for longer periods in recreational waters and are more likely than adults to swallow water intentionally or accidentally (WHO, 2003).

In many ENP countries, surface/coastal waters are very important for the national economy, especially in those countries where tourism activities in coastal areas are a key asset. Improving the quality of surface water therefore will be important not only to protect the health of local populations, but also to safeguard the future of a vital economic sector.

Considering the wider (environmental and social) benefits derived from water quality improvements is essential for the design of efficient water policy targets, to justify investment decisions for surface water restoration programmes and to set the right policies to reduce water pollution at source (i.e. allocation of permits, water pricing mechanisms).

<u>Methodological steps</u>

The following sections introduce the relevant methodological steps and necessary data for undertaking the benefits assessment for surface and bathing water quality. As the assessment is relatively more complex than for other parameters, further information and technical details on methodology employed for the monetary estimation of benefits derived from surface water quality improvements is provided in Annex V.

Data needed: see data checklist in Annex VI.

Step 1. Describe the state of the environment (at reference point: e.g. 2008 and/or most recent year available)

Provide a description of the current state of freshwater quality in your country (main regions). In particular, the description should include a number of data/information, some that will be crucial for conducting the assessment (priority information), some that will be important but less essential (desirable information), and some optional data that can provide some contextual information, which should be gathered if data are easily available (optional information). These are listed below.

Priority information:

- Number of rivers in the country and main regions (Number).
- Total river length in the country and main regions (km of river length).
- Current river water quality levels in the country/regions: km or % of total number of rivers achieving the different quality status labels used to assess river water quality in the country (the assessor is asked to provide a short note explaining these categories). If only qualitative judgement possible, the assessor may use the presence of key biological species as indicator of good/poor water quality, or use info on levels of pollution in main rivers. In addition, the assessor can produce a quantitative assessment of the number of rivers which are regarded as 'unpolluted' in the country and regions. Rivers regarded as unpolluted are those where there will be a diverse and natural range of plants, insects, fish, birds and other animals. Water will generally have the right degree of clarity, no noticeable pollution and generally be suitable for contact activities. No human health related incidents will have been reported recently.
- Number of lakes in the country and main regions (Number).
- Total lake area in the country and main regions (Surface area in hectares).
- Current lake water quality levels in the country/regions: ha or % of total number of lakes achieving the different quality status labels used to assess

lake water quality in the country (the assessor is asked to provide a short note explaining these categories). If only qualitative judgement possible, the assessor may use the presence of key biological species as indicator of good/poor water quality, or use info on levels of pollution in main lakes. In addition, the assessor can produce a quantitative assessment of the number of lakes which are regarded as UNPOLLUTED in the country and regions. Lakes regarded as unpolluted are those where there will be a diverse and natural range of plants, insects, fish, birds and other animals. Water will generally have the right degree of clarity, no noticeable pollution and generally be suitable for contact activities. No human health related incidents will have been reported recently.

- Number or size or geographical identification (i.e. location) of bathing areas.
- Number of households (divided by rural/urban areas and linked with income categories).
- Income per household (divided by rural/urban areas).
- Number of children per household.
- Male/female ratio.
- Education levels in the country. Ideally divided between no education, those who leave education before 16 years old and those who complete the whole schooling system and go into further education (above secondary school level).

Desirable information:

- Water use statistics:
  - Number of freshwater fishermen in the country and the main regions; Number of licences issued per year.
  - Survey results on attitudes: percentage of the total population who want to see improvements in water/environmental quality.
- General insights on state of bathing water/coastal areas.
- Importance of bathing areas for tourism and recreation (e.g. some information the economic relevance for the tourism sector) – this may only apply to some countries.
- Number of bathers (if this is not explicitly provided in official statistics, this can be based on: number of international tourists and of national tourists on the coast/along bathing areas + number of citizens living near the coast (i.e. inhabitants of counties that border the sea).
- Qualitative information on trends in the quality of bathing water (Improving? Deteriorating?).
- Qualitative views on the way changes in bathing water quality can affect tourism, recreation and health.
- Major environmental threats and opportunities for improvement of bathing water.

Optional information:

If additional data are easily available, please also provide information on (also covered under water resource scarcity):

- Pesticide consumption.
- Insights on negative environmental effects of water quality (e.g. eutrophication).
- Quality of ground water (if easily available)
  - pollutant concentration (nitrates, pesticides, others if important in the country.)
  - percentage of water bodies subject to salt intrusion
- Evidence of negative health impacts from bathing waters

Geographical coverage: Country and main regions. Please also include a rural/urban divide in the classification of current freshwater quality levels in the country.

Step 2. Define the baseline in time period of interest (e.g. 2020)

The baseline scenario is equal to the current water quality levels in the countries in the reference year (e.g. 2008)

It is necessary to estimate the percentage of freshwater units (river length or surface area for lakes) that would fall into each water quality category as used in Baker et al., 2007 (high, medium, low) per ENPI country. The table below outlines the water quality labels used for the ENPI study (based on Baker et al, 2007) and how they relate to the WFD quality labels.

If such a classification is not possible in the country under analysis, as a minimum requirement it would be required to identify the percentage of unpolluted rivers and lakes.

Table 6.11 Water quality classification

DEFRA water quality labels	***Description***	***WFD quality labels***	***Data needs***
High quality	High or Good Ecological Status (natural water bodies); Maximum or Good Ecological Potential (artificial or heavily modified water bodies)	High Status Good Status	Percentage of low, medium and high quality in national area at time=0 For the transfer exercise, we only need the % in the high quality (high and good) category. This can be the % of unpolluted rivers. The unit adopted to measure the 'quantity' of each status level is hectares of catchment area for rivers and hectares of surface water area for lakes, estuaries and coastal areas. Alternatives considered included the number of sites, as defined by the
Medium quality	Moderate or Poor Ecological Status (natural water bodies); Moderate or Poor Ecological	Moderate Status	

	Potential (artificial or heavily modified water bodies)	Poor Status	WFD, and a metric combining the surface water area for lakes, estuaries and coastal areas, with an approximation to river water surface area, based on kilometres of river.
Low quality	Bad Ecological Status (natural water bodies); Bad Ecological Potential (artificial or heavily modified water bodies)	Bad	

Source: Modified from Baker et al., 2007

Step 3. Target to be used

Development of improvement scenarios: Assume that different percentages of rivers and lakes will be improved to WFD good status levels by key dates up to the target year (e.g. 85 per cent, 65 per cent etc. depending on current status).

Rationale: Inspired by the EU Water Framework Directive (WFD) targets, which has the objective to bring all surface water in the EU at least to 'good' status by a key date (2015). For the design of different target scenarios, potential environmental improvements are measured against environmental targets set by the WFD. The targets used for the benefits assessment of surface water quality described in this manual are designed to approach compliance with the WFD at a national level for each individual ENPI country and for the Russian Federation. In practical terms this means that in the case of a country which is currently failing to achieve GES, the quantitative target is set to achieve that 85 per cent of all surface area of local rivers, lakes and reservoirs in the country improve to 'good ecological status' by 2020. This figure comes as an average between the 75 per cent and 95 per cent improvement scenarios used in the original valuation exercise; Baker et al., 2007.[26]

In the case of a country for which current quality levels state that 20 per cent of their rivers and lakes would comply with the targets of the WFD, the targets to be used would imply overall improvements in national water quality of 65 per cent for all surface waters in the country (the 65 per cent improvement scenario is the difference between the 85 per cent total compliance with the WFD scenario and current water quality levels in the country which are already GES – 20 per cent).

Development of improvement scenarios: Assume that different percentages of rivers and lakes will be improved to WFD good status levels by key dates up to the target year (e.g. 85 per cent, 65 per cent etc. depending on current status).

Step 4. Assess the environmental improvements

The environmental improvement consists of the increased share of surface water reaching at least good status if the target were to be met. This information is

[26] The 75 per cent and 95 per cent water quality improvement scenarios used in the original valuation exercise consider that it may not be possible/feasible in practical terms to achieve GES for all water bodies in the country by a certain date (i.e. 2020). The WFD allows for exemptions to the achievement of its environmental objectives based on grounds of disproportionate costs. It is therefore plausible to think that some rivers and lakes in the country will be too costly to restore and therefore the approach is mindful of this circumstance.

necessary to specify current water quality policy objectives in the country (e.g. targets to be achieved by a certain date according to the national classification scheme in use in the country).

Step 5. Assess the benefits

Most of the benefits will have to be assessed in qualitative terms, some of them in quantitative term and, if data allows, in monetary terms. An overview is provided in the following table, and the methodology for each type of assessment is explained below.

Table 6.12. Overview of the scale of the assessment: qualitative, quantitative and monetary analysis of benefits

Benefits	*Qualitative*	*Quantitative*	*Monetary*
Health	*YES*	*YES*	*YES*
Environmental	*YES*	*YES*	*YES*
Economic	*YES*	*NO*	*NO*
Social	*YES*	*YES*	*YES*

Qualitative assessment

Describe the benefits in qualitative terms. An overview of key benefits from improved surface water quality is provided in the table below. Through interviews and literature research, the following should be further developed and tailored to the country/local specific situation.

Table 6.13. Overview of key benefits:

Health benefits	The key diseases avoided are those of the alimentary system. Microbial - bacterial and viral - contaminants can cause a range of problems from mild disorders to major diseases such as dysentery. Some disease will occur from infection from regularly occurring intestinal bacteria, while others are diseases passed on from those already infected. Treatment to remove common bacteria (such as faecal coliforms) will also destroy a wide range of more dangerous, if infrequent, bacterial diseases.
Environmental benefits	The presence of pollutants/toxic substances in water (e.g. metals, pesticides) are well known to affect a wide range of species, both freshwater and marine. These may be affected by direct toxic effects on metabolism and the disruption of endocrine functions. Some substances can also be accumulators both within the environment (e.g. in sediments) and within animals (bioaccumulation). Therefore they can represent a significant threat even in small concentrations. Excessive concentrations of nitrates can also cause extensive harm to the environment through eutrophication; nitrates greatly stimulate the growth of algae. The decomposition of such algae reduces the water's dissolved oxygen content, adversely affecting fish and other aquatic life forms.
Economic benefits	Cleaner surface water resources can reduce costs to industry (e.g. for pre-treatment) and stimulate eco-technologies (e.g. for water treatment) and

	improved farm practices (e.g. more efficient use of fertilisers and pesticides). Coastal bathing areas, especially in the southern ENPI countries, have a strong potential for tourism. An improvement in quality of bathing waters (where this is currently poor or below standards) can ensure that more tourists are attracted to the area and thus improve revenues for local economy.
Social benefits	Water pollution and eutrophication can reduce the amenity value and tourism development benefits to local communities by restricting the recreational use of waters. Pollutants can also have effects on health (see above) and therefore can place a strain on social support systems within a community and lead to a feeling of isolation of that community from the social structure of the country as a whole.

Quantitative and Monetary assessments

The assessment used in the ENPI study builds on an econometrics approach, which allows for the inclusion of local environmental and socio-economic conditions in the estimation of WTP values but is relatively complex to replicate. The formulae, rationale and additional information are provided in Annex V.

Countries wishing to do a somewhat less complex order of magnitude estimate could follow the steps:

- Assess/map the surface waters (rivers, lakes, coastal areas) and note length/areas as well as quality levels.
- Assess what share already at good ecological status / what share could potentially be improved (eg by a step in river quality classification).
- Map/assess who are the (potential) beneficiaries of the surface waters (population for recreation, fishing (recreational and commerical etc)
- Multiplying the share that could be improved by a quality classification with the associated beneficiaries to determine the number potentially benefiting from the quality improvements.
- Explore appropriate unit benefits values for quality improvements for different beneficiaries – e.g., WTP for local population for recreation, WTP or expenditure for domestic or international tourists (eg for bathing waters), WTP or catch levels for fish – ideally using a range of values to illustrate the uncertainty surrounding the value transfer exercise.
- Multiply the number of beneficiaries across types with the appropriate unit value ranges to give total values.
- Ensure that population, baseline trends in income, and potentially tourism/recreation levels are factored into the baseline so that the total assessment captures the major trends.

Previous benefits studies for EU enlargement (Ecolas and IEEP. 2005;Arcadis-Ecolas, et al. 2007) adopted such a pragmatic approach, looking at the length of rivers that could see an improvement in ecological status classification and multiplied by a WTP range, which is directly transferred from other valuation studies undertaken elsewhere, and also looking at tourism levels and expenditure (domestic and international) for bathing waters and combined with areas potentially at risk, and/or potentially benefitting from improved ecological status from upstream activities to derive benefits assessments.

6.2.2 Water resource scarcity

Definition of the parameter

The parameter measures the total freshwater abstracted (withdrawal) and compares this to the total actual renewable water resource. The following definitions apply (FAO, 2003 and EEA, 2009):

- *Water resource scarcity*: For the purpose of this assessment, water resource scarcity is taken to cover the availability of renewable freshwater and the extent of its use.
- *Agriculture water:* Water supplied to crop production, animal husbandry, hunting, fishing and forestry.
- *Municipal water*: Water supplied to the community and individuals.
- *Industry water*: Water supplied for the production of non-food products.
- *Total withdrawal:* This is a sum of all the water that is abstracted from surface water bodies, ground water bodies and seawater that is desalinated.
- *Surface water*: All surface water generated internally plus surface water flowing in internationally, minus surface water flowing out internationally.
- *Ground water*: All ground water generated internally plus ground water flowing in internationally, minus ground water flowing out internationally.
- *Desalinated water:* Potable water obtained from treatment of saltwater.
- *Waste water reused:* Water obtained from treatment of waste water available for re-use.
- *Water available (replenishment) TARWR*: The maximum theoretical amount of water actually available for the country (Total Actual Renewable Water Resources (TARWR)), calculated from:
  (a) Sources of water within a country itself;
  (b) Water flowing into a country, and;
  (c) Water flowing out of a country (treaty commitments).
- *Total Actual Renewable Water Resource* (TARWR) is the sum of:
  - External water resources entering the country
  - Surface water runoff (SWAR) volumes generated in the country
  - Ground water recharge (GAR) taking place in the country

  Less:
  - The volume of the total resource in the country which is effectively shared as it flows in both the groundwater and surface water systems - not to subtract this volume would result in its being counted twice. FAO refers to it as ‘Overlap’
  - The volume that flows to downstream countries based on formal or informal agreements or treaties.

In this calculation TARWR is added to the water obtained by desalination and waste water re-use.

Unit of measurement (indicator):

- Water Exploitation Index (WEI)

According to the European Environment Agency (2009), one relatively straightforward indicator of the pressure or stress on freshwater resources is the Water Exploitation Index (WEI) (also known as the Water Stress Index and Relative Water Stress Index). This is calculated annually as the **ratio of total freshwater abstracted (withdrawal) to the Total Actual Renewable Water Resource (TARWR)**. A WEI above 20 per cent implies that a water resource is under stress and values above 40 per cent indicate severe water stress (Raskin et al., 1997).

Water Exploitation Index = Total withdrawal per year / TARWR

Other secondary indicators:

- Water Available per Capita = TARWR/population
- Total Water Use per Capita = Total withdrawal per year/population
- Municipal Water Use per Capita = Municipal withdrawal per year/population

Rationale for choice: These indicators are internationally recognised by the FAO and European Environment Agency and data is generally readily available. Use 'actual' water resources available rather than 'natural'.

Limitations to the indicators include the fact that they do not cover seasonality issues and they do not address different regional water resource issues within large countries. In addition, the water scarcity index can overestimate water stress where water is abstracted for power use and is returned to the source.

Although indices are being developed for assessing environmental water requirements to maintain key ecological features of rivers and water bodies, the complex data requirements do not lend themselves for this assessment. An overview of the Environmental Water Scarcity Index by basin can be found here http://prelive.earthtrends.org/pdf_library/maps/watersheds/gm16.pdf

Methodological steps

The key points of the assessment are the analyses of:

i) The current status and importance of the water that is available.
ii) Current trends in water availability, use and management (based on changes in supply and demand pus management efforts); and
iii) What the benefits would be of moving from the baseline to a lower water exploitation index, plus more integrated management of water based on controlling supply and demand.

The steps of the analysis are described in more detail below. An Excel worksheet is also provided in Annex VII to help carry out some of the calculations.

Data needed: see data checklist in Annex VI.

Step 1. Describe the state of the environment (at reference point: e.g. 2008 and/or most recent year available)

Describe the current state of water stress in terms of water sources and demand usage. In addition, a **brief overview** (a few sentences only) of other relevant information should be provided to give additional national context, drawing upon readily available information. For example, the following could usefully be covered:

- **Renewable water supply volumes**
- **Water used for agriculture, industry and households**
- Sustainable groundwater yield – if readily available.
- High level data on rivers, lakes, reservoirs, glaciers, irrigation canals (e.g. total length, water capacity) etc.
- Extent of water re-use and desalination etc.
- Other key water requirements e.g. for natural habitats, fisheries and navigation.
- Key problems in the country relating to water resources e.g. constraints and impacts on agriculture, industry, households and wetland habitats (e.g. rivers, wetlands running dry).
- Extent that freshwater flooding is a problem.
- Existing degree of integrated water resource management and water use charging.

Geographical coverage: Focus on the national level. However, comment on key regional differences if important (e.g. specific regions prone to drought, water shortages, floods etc.).

Summary of key data needs (see also data checklist in Annex VI):

- Rivers, lakes, reservoirs, glaciers, irrigation canals (e.g. total number and water capacity etc.) etc.
- Re-use, efficiency of use and desalination etc.
- Other key water requirements e.g. protected wetland areas, fisheries and navigation.
- Extent that water resources are a problem in the country e.g. constraints and impacts on agriculture, industry, households and wetland habitats/biodiversity (e.g. numbers and frequency of rivers, lakes and wetlands running dry).
- Extent that freshwater flooding is a problem.
- Incidences of freshwater flooding and areas most exposed
- Water availability (various sources)

- Water withdrawal (various users)
- Index of water stress

Step 2. Define the baseline in time period of interest (e.g., 2020)

Estimate the likely water availability and abstraction in 2020 if data is readily available (e.g. through projected demand from industry, agriculture and municipality/household use and predicted changes in water availability due to climate change). Where available, mention data on planned desalination and waste water re-use etc. If no such projections are readily available, assume that the state of the environment regarding water scarcity in 2020 will be similar to the state today, or use an 'assumed percentage change' – or extrapolate/interpolate from any other existing estimates for other time periods. If data is readily available on changes in agricultural and industry output, then refer to this. If there is major uncertainty over the likely water use projections in 2020, then it may be better not to make an inaccurate estimate but rather to state the potential baseline in qualitative/descriptive terms.

Summary of key data needs (see also data checklist in Annex VI):

- Projected demand from industry, agriculture and municipality/household use – or annual or predicted change in output for industry and agriculture (e.g. World Bank country strategy data).
- Predicted changes in water availability e.g. due to climate change, re-use, desalination etc.
- Data on expected population size in 2020

If the above data on; projected demand from industry, agriculture and municipality/household use, predicted changes in water availability and expected population size in 2020 are available, calculate a revised water exploitation indicator and other indicators with 2020 predictions. The revised data (projections) should be included in the worksheet provided. However, if such data is not available or reliable, then no calculation is needed – simply describe the projected baseline.

Step 3. Target to be used

Due to the complexity of water resource use and management and the considerable contextual variation between the countries, it was not considered appropriate to recommend a specific water exploitation target for the ENPI study. However, the EU suggests that countries should, where appropriate, aim to lower their WEI towards 20-40 per cent.

What is more important is that where there is a water scarcity issue, a sustainable 'demand-led' approach to 'integrated water resource management' is adopted, focusing on conserving water and using it more efficiently. Integral to this is a more equitable approach to water abstraction that addresses not only the requirements of competing economic sectors, but also the need for healthy freshwater ecosystems.

In doing so, the following Millennium Development Goals (MDG), as well as transboundary water sharing issues, should also be targeted:

a. Ensure appropriate environmental flows are ensured to maintain wetland goods and services;
b. Change social, economic and regulatory instruments that are inappropriate for water allocations and uses;
c. Mediate water conflicts across the sectors through participation of appropriate stakeholder groups, and;
d. Mediate transboundary water sharing/conflicts to achieve equitable water allocation among riparian countries.

Step 4. Assess the environmental improvements

The 'environmental improvements' associated with moving from the baseline to the targets described above are likely to reduce the WEI and relate to benefits such as increased water availability for use during summer months and more water in the rivers, lakes and wetlands. In addition, the increased volume of water within surface and ground waters will potentially improve water quality through diluting pollution loads.

Step 5. Assess the benefits

Within the ENPI country studies, most of the benefits had to be assessed in qualitative terms and some of them in quantitative terms where existing data available. An overview is provided in the following table, and the methodology for each type of assessment is explained below.

Table 6.14 Overview of the scale of the assessment: qualitative, quantitative and monetary analysis of benefits

Benefits	*Qualitative*	*Quantitative*	*Monetary*
Health	YES	NO (unless existing data)	NO (unless existing data)
Environmental	YES	NO (unless existing data)	NO (unless existing data)
Economic	YES	NO (unless existing data)	NO (unless existing data)
Social	YES	NO (unless existing data)	NO (unless existing data)

Qualitative assessment

Describe the main benefits, for example as suggested in the table below, and add any others from relevant national studies.

Table 6.15. Overview of key benefits

Health benefits	Reduction in diseases related to a scarcity of water for human consumption (avoid duplication with drinking water and sanitation – focus only on the benefits to increased availability rather than quality). In many ENPI countries these benefits are expected to be relatively small. Health is also expected to increase if food crop loss due to drought is avoided, and due to an improved diet if there is an increase in fish numbers in rivers.
Environmental benefits	Avoidance of low river flow situations which cause higher pollution concentrations and fish kills. If better managed, there will be more water available to maintain and enhance habitats and species that depend upon wetlands, rivers and lakes.
Economic benefits	Reduced loss of crops and livestock due to droughts. Increased agricultural output through more efficient irrigation. An increase in industry that requires water. Enhanced river fishing. Enhanced trade and transport on rivers.
Social benefits	Navigable channels can be maintained and controlled to provide access. Enhanced quality of life if living near and using 'healthy' rivers and lakes. Greater use of water bodies for amenity and tourism value (although this will be covered under 'surface water quality' benefit assessment and duplication should be avoided, but do highlight if such benefits are particularly related to water quantity/availability rather than quality).

Quantitative assessment

If quantitative data is readily available through previous water resource studies, then use this. This could relate to averting past incidences of water stress (area affected, level of stress, number of people affects) and droughts (e.g. crop and livestock failures - quantities) or predictions of future benefits from reduced water scarcity (e.g. enhanced crop and livestock productivity).

Monetary assessment

As above, only use monetary data if already available in existing reports or studies for the country or region e.g. values indicating the potential financial costs of loss of agricultural outputs due to drought. If it seems relevant and appropriate, an average cost of providing desalinated water could be stated.

It is worth pointing out that the potential economic losses associated with droughts and reduced crop outputs can be substantial. The reaction of farmers to unreliable water supply, namely that farmers tend to grow less profitable crops which require minimal agricultural capital accumulation (i.e. single-season crops) to limit their losses in the event of water scarcity, can be used as a proxy for assessing the monetary value of improving water resource use. Should a value for the cost of water supply uncertainty be estimated/become available in the literature (in € or LCU per m^3), this could be used to monetise the economic benefits for agriculture of improved water availability. An example is available from Lavee (2010).

7 METHODOLOGY FOR ASSESSING WASTE RELATED BENEFITS

The benefits of a sound waste management system expand beyond keeping the day-to-day living environment in the cities clean and tidy. Waste management mainly generates benefits in the field of hygiene through; the abatement of wild tipping or wild burning both in cities and rural areas, protection of surface and ground water, avoiding air pollution, landscape care, environmentalism and tourism, reduced CO_2 emissions and climate change, reduced resource depletion, cleaner energy production and the availability of secondary raw materials from the recycling industry. A sound waste management system contributes to social benefits through job creation and, by applying the self-sufficiency principle, it avoids local or foreign eco-dumping.

The theme covers the following subthemes and parameters:

- Sub-theme: Waste Collection
  - Parameter: Waste Collection Coverage
- Sub-theme: Waste Treatment
  - Parameter: Waste Treatment
  - Parameter: Methane Emissions from Waste

The methodology for assessing waste related benefits aims to help officials and policy makers to assess the environmental, health, economic and social benefits of an enhanced municipal waste policy. It is developed as a user friendly instrument for experts and non-experts in the field of waste management. Next to this text an Excel tool is available. The structure of this methodology reflects the structure of the Excel tool; it can be read as an introduction and a manual for this tool.

Changes in waste management are defined in terms of:

- enhanced collection coverage of the population for municipal solid waste (household waste and comparable waste)
- less unmanaged waste dumpsites
- increased capacity of sanitary landfills
- increased recycling or energy recovery
- increased collection of methane (landfill gas) from sanitary landfills

A transparent and straightforward model calculates the benefits in quantities of treated waste, jobs generated, societal benefits generated and monetary benefits. It can help to put waste issues higher on the political agenda or to motivate changes in waste management policies.

The benefits can be calculated for the whole country or for a geographic part of the country (a region, a city) as long as the basic data mentioned below (Table 8.1-5) are available.

The calculations are based on:

- a minimum of available national or regional data
- the definition of simple targets
- the setting of a time horizon to reach the targets
- the setting of a (final or intermediate) time horizon to measure the benefits

The situation in a *'baseline scenario'* is compared to the situation in a *'target compliant scenario'*:

- The baseline scenario calculates the effects of continuation of the current practice on waste collection coverage and waste treatment from now to a set time horizon. No changes in the waste policy occur.
- The target compliant scenario describes what would happen if the set targets would be met.

The benefits are the difference between these two scenarios.

The Excel worksheet provided in Annex VII is structured as illustrated in the table below.

Introduction	A page with introductory information.
Basic data	A fill-in page with basic statistics on waste management.
Waste collection coverage	A (optional) tool to assess in more detail the waste collection coverage in the baseline scenario, especially taking into account differences between rural and urban population.
Future municipal waste generation	Calculation of the future municipal waste generation and composition.
Benefits of better collection	Calculation of the environmental and socioeconomic benefits of better municipal waste collection.
Benefits of better treatment	Calculation of environmental and socioeconomic benefits of better municipal waste treatment.
Benefits on climate change	Calculation of environmental and socioeconomic benefits of landfill gas capture.
Summary	A summarising sheet with the main conclusions on achievable benefits.

Data collection

A limited set of basic data has to be collected and will be used throughout the analysis on all three parameters; waste collection, waste treatment and waste related greenhouse gas emissions.

Next to the quantitative data as mentioned in this chapter, the analyst needs to collect qualitative information on the actual waste management situation, in order to be able to interpret and frame the obtained results.

In the Excel tool a tab is dedicated for input of the basic data, by way of a simple fill-in form:

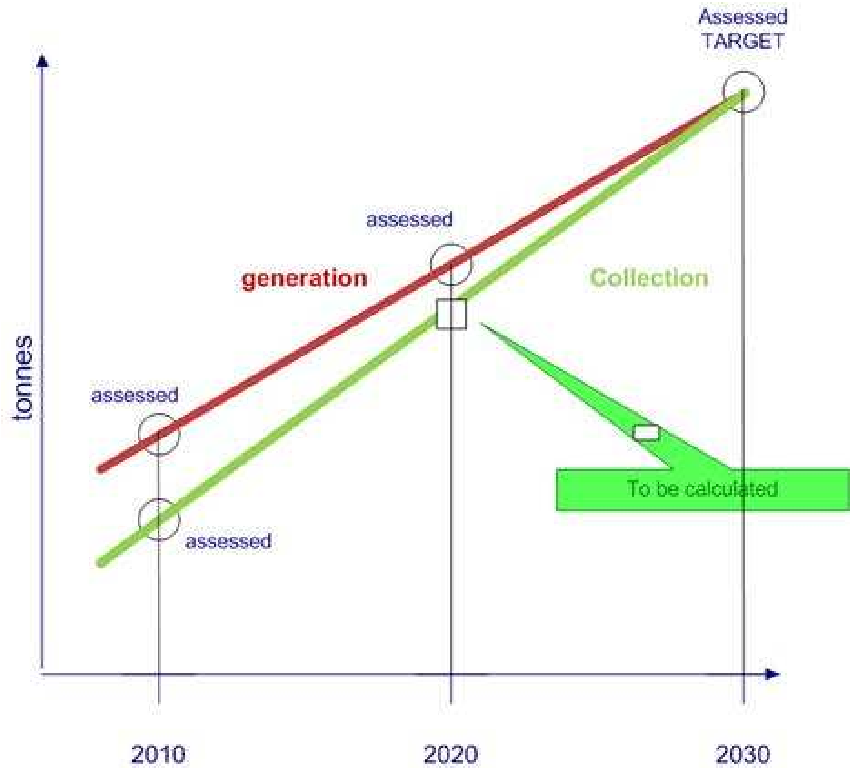
- yellow boxes are 'obligatory' (i.e., to be able to ensure that an answer of at least minimum quality is obtained)
- green boxes are optional but may enhance the quality of the outcome
- pink boxes are to be filled in if needed,
- grey boxes are not to be filled in as they contain calculated outcomes

When collecting data, the following definitions apply:

Country or region *(name)*	The analysis can be done for a whole country or for a region, a city or a geographical part of it.
Year of the basic data (**basic year)**	Unless otherwise stated, the basic data collected refer to this year. If data are not available, data from the previous or the next year can be used as an approximation.
Year in which the targets will be reached **(target year)**	Ambitious or less ambitious targets can be selected. You can freely choose, for the sake of the analysis, a year for which you assume that the target can or should be met. Choose a realistic option in function of the ambition of the targets and the actual situation (the distance-to-target to be gapped).
Year for which the benefits have to be calculated **(benefits year)**	The year in which the targets will be reached, or any year in between, for which we would like to know the benefits. Benefits are always calculated for a single year. We assume a linear evolution towards reaching the target.

The distinction between baseline year, target year and benefits year is illustrated below. In this example the basic data refer to 2010, we assume that in 2030 the targets will be reached (e.g. full collection coverage), and we would like to know the socioeconomic benefits in 2020.

Figure 7.1 Relation between basic year, target year and benefits year



The key data to be collected (on demographics, economics, municipal waste generation, waste composition and treatment) are listed in the tables below.

Table 7.1 Demographic data

Actual population in the basic year	Expressed as number of inhabitants.
Actual urban population in the basic year	Expressed as number of inhabitants. This is facultative i.e. only useful if you also fill in average waste generation per capita for urban and rural population.
Actual rural population in the basic year	
Actual household size	
Year for which future population is assessed	Based on available data, the number of inhabitants can be filled in for a future year. This year can be the same as, or different from, the target year but it is preferable to use a year as close as possible to the target year. These data are used to calculate a yearly growth rate for the total population. If another (better) value for growth rate is available from alternative sources, this growth rate can be input directly in the following field.
Future population	
Yearly growth rate from a better source	Fill in - if available and reliable - a yearly growth rate percentage for population.

Table 7.2 Economic data

Currency used in this exercise (LCU)	Give the abbreviation of the local currency unit that will be used in this analysis. The results will be expressed in this unit. If you would like to obtain the result in euro or dollar or, fill in € or $
Actual exchange rate	Fill in the exchange rate to be used in this exercise. This is needed to provide standardised values expressed in euro; 1 LCU = ? €
Actual GDP	Expressed in LCU billion.
Year for which future GDP is assessed	Based on available data, the GDP can be filled in for a future year. This year can be the same as, or different from, the target year but it is preferable to use a year as close as possible to the target year
Future GDP	These data are used to calculate a yearly growth rate for the GDP. If another (better) value for growth rate is available from alternative sources, this growth rate can be input directly in the following field.
Yearly GDP growth rate from a better source	Fill in - if available and reliable - a yearly future growth rate percentage for GDP.
Average yearly fee in the country or region, preferably for a waste treatment worker	Expressed in LCU (local currency unit).
Average yearly income per inhabitant	GNI per capita; a possible data source is the World Bank world development indicators. Expressed in LCU.

Table 7.3 Data on average municipal waste generation

Actual municipal waste generation in the basic year	Fill in as kg/inhabitant/year. An average for the whole country or region should be examined.
Actual urban municipal waste generation in the basic year	Expressed as kg/inhabitant/year. This is facultative i.e. only useful if you also fill in values for urban and rural population.
Actual rural municipal waste generation in the basic year	

Table 7.4 Data on average municipal waste composition

Organic waste (%)	Analyse the average composition of the mixed municipal waste: check the content of an average garbage can, container or refuse bag, as disposed of by average households. Add (if occurring) quantities of separately collected municipal waste fractions (paper, plastics, metals etc.). If for a certain waste stream no data are available, leave the field open. The fraction is then assumed to be part of 'other'. Note the total should be 100%.
Plastics (%)	
Paper/cardboard (%)	
Textiles (%)	
Metals (%)	
Glass (%)	
Other (%)	

Table 7.5 Data on waste treatment

Waste collection coverage	Percentage of population served by frequent municipal waste collection. We assume that non-collected municipal solid waste is disposed of by the inhabitants themselves: wild or unmanaged dumpsites, fly tipping, burial, burning etc.
% Collected waste dumped in non-controlled dumpsites	This percentage accounts for the amount of waste being collected through municipal waste collection schemes, and after collection, being dumped on non-managed dumpsites rather than collected waste that is disposed of on well-managed sanitary landfills.
% Landfilled in controlled landfills	This percentage accounts for the amount of waste being collected through municipal waste collection schemes, and after collection, being disposed of on well managed sanitary landfills.
% Incinerated	This percentage accounts for the amount of waste being collected through municipal waste collection schemes, and after collection, being incinerated in waste incineration plants or waste-to-energy installations.
% Recycled	This percentage accounts for the amount of waste being collected through municipal waste collection schemes, and after collection, being recycled to generate new materials which return to the economy.
% Bio waste composted	This percentage accounts for the amount of waste being collected through municipal waste collection schemes, and after collection, being composted.

See also the data checklist in Annex VI.

7.1 Sub-theme: WASTE COLLECTION

This sub-theme encompasses the benefits from increasing and improving waste collection in urban and rural areas. It is understood that not all citizens benefit from centralised waste collection services. Especially in rural or less densely populated areas, people can be excluded from a collection system set up by its municipalities, and have to manage their municipal waste themselves. This leads to wild tipping, the use of non-controlled dumpsites, burning or burying of all kinds of municipal waste. Although the degree of waste reuse can be very high and inventive in non-covered rural areas, the shift in consumption patterns (e.g. the widespread use of plastics or of hazardous substances) can cause problems, even in an agricultural subsistence economy, the likes of which did not occur in a pre-industrialised world where waste could be easily managed by traditional means.

7.1.1 Waste collection coverage

Definition of the parameter

The parameter measures the number of people served by a collection system for municipal waste.

The following **definitions** apply:

- *Waste:* everything one discards, intends to discard or is obliged to discard (definition in line with the EU Waste Framework Directive). Included is waste destined for recycling, even after a pre-treatment step. Excluded is clean soil, manure and nuclear waste. Economic value is no criterion to include or exclude something as a waste.
- *Municipal solid waste* (MSW): waste collected by services for the collection of household waste. It may contain waste from small enterprises or municipal services collected in the same collection scheme. Large quantities of construction and demolition waste and end-of-life vehicles are excluded, even if generated by households. Industrial, agricultural and medical wastes are also excluded.
- *Collection system:* any kerbside collection or bring-system that is set up and managed by the municipality, or on its behalf, to collect mixed municipal waste and provide a centralised waste treatment solution, even if this solution is not ecologically sound. Excluded from this definition is occasional, often private, collection of recyclable wastes with an economic value, such as metals or rags.

Unit of measurement (indicator): Waste collection service coverage (% of population covered), covering both urban and rural population.

Rationale for choice: In many countries waste collection is likely to be poor and waste generation is growing (health impacts; amenities).

Methodological steps

Data needs: see tables 8.1-5 above and data checklist in Annex VI.

Step 1. Describe the state of the environment (at reference point: e.g. 2008 and/or most recent year available)

In order to provide a description of the status of waste collection, the following steps should be followed:

- Describe the context of waste management in the country and waste generation.
- Describe the existing waste collection system; the way the collection is handled, highlighting key problems and opportunities for improvement.
- Assess quantitatively the rate of coverage. Keep in mind that the collection coverage or the collected quantities are NOT equal to the amount of waste generated. Use data or statistics locally available. If no direct data on collection rates are available (e.g. from collection fees or other administrative sources or from the collection services), assess the average collection coverage for different sizes of settlements and use data on the distribution of the total population over the different sized cities and settlements.
- Assess quantitatively the amount of waste not covered by municipal waste generation.

Geographical coverage: the whole territory of the country.

Step 2. Define the baseline in time period of interest (e.g. 2020)

The Excel tool provides an elaborated assessment of actual and future collection coverage in the baseline scenario.

An alternative, simplified approach is presented below. This is an optional tool to take into account collection coverage in the baseline scenario, as this can shift due to the effects of rural migration and the different level of collection coverage in rural and urban areas. The outcome can be used as input for the calculation of the benefits from better waste collection.

Required input is:

- Percentage of all people living in rural settlements <1,000 inhabitants, or dispersed, and served by waste collection in the basic year
- Percentage of all people living in settlements between 1,000 – 10,000 inhabitants served by waste collection in the basic year
- Percentage of all people living in settlements between 10,000 – 100,000 inhabitants served by waste collection in the basic year
- Percentage of all people living in settlements >100,000 inhabitants served by waste collection in the basic year
- The actual distribution of the population (in percentages) over the four above mentioned settlement types, in the basic year

- The assessed future distribution of the population (in percentages) over the four above mentioned settlement types, for the target year

Demographic data or rural and urban settlement in the reference year (e.g. 2008) and target year (e.g. 2020) should be included in the table below.

Table 7.6 Settlement size – current and future

	% Of total population in the basic year	Assessed % of total population in the target year
Rural settlements < 1,000 inhabitants or dispersed		
Settlements between 1,000 – 10,000 inhabitants		
Settlements between 10,000 – 100,000 inhabitants		
Settlements > 100,000 inhabitants		

The relative shift in the distribution of the population, as percentages over small and larger size settlements, is calculated for the target year and all years in between, and the average collection coverage for the whole country or region can be calculated.

Calculation of future municipal waste generation

The assessment of future municipal waste generation is needed to draft the baseline scenario and the target compliant scenario. It is based upon the collected data on municipal waste generation and composition, and on the trends for demographic and economic growth.

The population grows in line with the demographic growth rate as assessed or calculated in Table 8.1 above (see also the assumptions used for the ENPI study in chapter 5.5). The total waste generation is calculated by multiplying the average generation per capita by the total population.

The average waste generation per capita grows in line with the economic growth rate as assessed or calculated in Table 8.2 (see also chapter 5.5). It is assumed here that waste generation and economic growth are correlated; this assumption is acceptable within the near future but it becomes less reliable for the more distant future[27].

The total generation of waste is assumed to be the same in the baseline scenario and in the target compliant scenario. No measurable preventative effects are assumed to take place in the target compliant scenario.

27 The assumption that waste generation is proportionally coupled to GDP is retrieved from the hypothesis of so called Environmental Kuznets. These are based on the empirical finding that the environmental impact (or its sources like waste generation) increases in line with economical growth but that after a while the environmental impact stabilises or even starts to decrease.

Step 3. Target to be used

The target is defined as reaching 100 per cent collection coverage of the whole population, rural and urban, in the target year. To reach this target, collection coverage has to increase by a yearly percentage. The Excel tool calculates this percentage.

The target year is best set relatively far in future, because of the ambitious character of the targets. In the ENPI study, the target year was 2030, but this assessment calculated to what degree progress would be made on these targets in 2020 in order to make the analysis comparable with the other parameters (whose target year was 2020).

Rationale: collection leads to considerable avoided impact from wild dumpsites or wild burning.

Step 4. Assess the environmental improvements

The environmental improvement consists of the amount of waste that is additionally collected in the target compliant scenario compared to the baseline scenario.

Step 5. Assess the benefits

Most of the benefits will have to be assessed in qualitative terms, some of them in quantitative term and, if data allows, in monetary terms. An overview is provided in the following table, and the methodology for each type of assessment is explained below.

Table 7.7. Overview of the scale of the assessment: qualitative, quantitative and monetary analysis of benefits

Benefits	*Qualitative*	*Quantitative*	*Monetary*
Health	*YES*	*NO*	*(under 'waste treatment')*
Environmental	*YES*	*YES*	*(under 'waste treatment')*
Economic	*YES*	*YES*	*YES*
Social	*YES*	*YES*	*(under 'waste treatment')*

Qualitative assessment

Describe the benefits in qualitative terms. An overview of key benefits from improved/increased waste collection is provided in the table below. Through interviews and literature research, the following should be further developed and tailored to the country specific/local situation.

Table 7.8. Overview of key benefits

Health benefits	Health benefits can result from avoided pollution of soil, ground water and air due to wild dumping or burning of waste. Illegal dumps can also attract rodents, which can be vectors for disease. Furthermore, where there are cases of local populations involved in informal waste collection (e.g. scavengers and the Zabbaleen in Cairo), there can be cases of contamination due to the handling of waste material.
Environmental benefits	The reduction in waste being illegally dumped/not collected will improve the landscape and reduce risk of pollution/contamination e.g. of surface, underground and marine water.
Economic benefits	There will be benefits from tourism, job opportunities for waste collection etc. There may also be efficiency gains e.g. in fisheries - there is a case study in northern Lebanon on the time wasted by fishermen clearing their nets of waste.
Social benefits	There can be benefits from improved environment in the cities e.g. in some countries this can increase the sense of community, and can be an opportunity to generate jobs locally etc. There will also be benefits related to reduced odour and visual pollution (although this may be difficult to monetise, unless it directly affects amenities and/or recreation).

Quantitative assessment

- **Environmental benefits**

The quantitative environmental assessment focuses on the environmental benefits of reducing the area of land polluted by uncollected waste/dumpsites, thanks to the expansion of the collection coverage.

In order to calculate the environmental benefits, the following are assumed (EuropAid, 2009):

- Waste not collected is predominantly dumped on dumpsites or wild tipped, littering the terrestrial habitat.
- Average dumpsite depth = 1 m
- Average density of dumped waste = 340 kg/m^3
- Volume reduction factor: 0.67 - we assume that by biodegradation and by dumpsite fires the volume of dumped waste will reduce with a factor of 2/3

These assumptions can be adapted to local conditions.

Based on these data the total surface area (expressed in m^2) for which pollution can be avoided can be calculated.

- **Economic benefits (Job creation)**

A rough assessment of economic benefits can be done by estimating the impact on job creation of an expanded waste collection system (EuropAid, 2009).

The proposed model assumes a theoretical collection efficiency of 900kg/h per waste collector, in case of weekly collection using modern collection techniques and an average work day of 7 hours and an average work year of 220 days. These assumptions can be adapted to local conditions.

Total person-years of jobs created through supplementary waste collection can be calculated accordingly.

Monetary assessment

- **Overall benefits of improved waste management**

See chapter 8.2.1 for the assessments of the benefits from both collection and safe treatment of the waste.

- **Economic benefits (Job creation)**

If data on average wage are available in the country under analysis (see Table 8.2), this can be multiplied by the total person-years of jobs as calculated above, to estimate the total value of supplementary generated wages.

7.2 Sub-theme: WASTE TREATMENT

The distribution of the collected waste over landfill, incineration, composting and recycling is investigated and compared to substandard dumping of the collected waste or with wild dumping or burning of non-collected waste. The amount of methane emissions from landfills saved if appropriate methane capture devices are used is also assessed.

7.2.1 Waste treatment

<u>Definition of the parameter</u>

The parameter includes quantities and environmental impacts of waste landfill, incineration, composting and recycling, compared to wild dumping or burning.

The following definitions apply:

- *Waste:* everything one discards, intends to discard or is obliged to discard (definition in line with the EU Waste Framework Directive). Included is waste destined for recycling, even after a pre-treatment step. Excluded is clean soil, manure and nuclear waste. Economic value is no criterion to include or exclude something as a waste.
- *Municipal solid waste* (MSW): waste collected by services for the collection of household waste. It may contain waste from small enterprises or municipal

services collected in the same collection scheme. Large quantities of construction and demolition waste and end-of-life vehicles are excluded, even if generated by households. Industrial, agricultural and medical wastes are also excluded.

- *Landfill:* disposal in managed sanitary landfill sites with at least an impermeable bottom liner, leachate capture, daily coverage, fencing and permanent staff. To be distinguished from unmanaged dumpsites.
- *Incineration*: thermal destruction of waste in dedicated installations equipped with flue gas treatment, or co-incineration in energy plants or cement kilns working at comparable environmental conditions. To be distinguished from wild or uncontrolled occasional burning of waste.
- *Recycling*: making a usable non-waste product out of waste. The recycling process does not stop at the level of pre-treatment (e.g. sorting) but ends when the waste is used as a raw material to make a non-waste product.

Unit of measurement (indicators):

- Amounts and percentage of total waste and municipal waste being sent to different waste treatment alternatives.

Rationale for choice:

The environmental impact of waste and the benefits of waste treatment are only in part related to the generation of the waste; the treatment of waste is also a significant contributing factor.

Methodological steps

Data needs: see tables 8.1-5 above and data checklist in Annex VI.

Step 1. Describe the state of the environment (at reference point: e.g. 2008 and/or most recent year available)

- Total municipal waste landfilled annually: this can be derived from the annual capacities of the available landfills.
- Major problems concerning waste landfilling: qualitative description
- Number and capacity of managed landfills with at least an impermeable bottom liner, leachate capture, daily coverage, fencing and permanent staff. To make a rough assessment of yearly capacity, estimate the total lifetime of a landfill at 20 years and divide the total designed capacity of a landfill by 20.
- Condition of official (licensed or legal) landfills. Make a qualitative judgement on their condition e.g. % good, % bad.
- Number of illegal or non managed dumpsites and type of waste therein. To estimate the quantities of waste dumped on them: take the total generation of waste, subtract the amount of waste not collected, subtract the amount of waste landfilled in managed landfills, and subtract quantities of waste treated using other waste treatment options like incineration, recycling etc.
- Total municipal waste incinerated or used to produce energy, if any - please describe

- Total municipal waste recycled, if possible make a distinction between type of waste e.g. paper, metal, glass, etc.
- Number and capacity of existing recycling facilities, and presence of informal recycling economy; metal and scrap recycling, glass recycling (e.g. pierres nevada), reusable packaging collection etc.
- Number and capacity of centralised composting facilities, total amount of waste composted
- The sum of waste composted + paper recycled + textiles recycled corresponds to the amount of biodegradable waste diverted from landfills, if no waste incineration occurs.

Geographical coverage: the whole territory of the country.

Step 2. Define the baseline in time period of interest (e.g. 2020)

The baseline scenario is calculated by applying the current percentages of collected waste over different waste treatment options (dumping, landfill, incineration, recycling or composing – see table 8.4) to the assessed total waste generation and collection in the baseline scenario in chapter 8.1.1. A shift in the composition of the generated municipal waste between now and the target year is assumed, in line with shifts in lifestyle. The assumption is made that the future municipal waste composition will align with the composition of some EU Member States (Bulgaria is taken as a model but the Excel tool allows to change these values) – see table below.

Table 7.9 Bulgarian benchmark values

Organic waste	44%
Plastics	13%
Paper/cardboard	16%
Textiles	6%
Metals	5%
Glass	9%
Other	7%

Source: ARCADIS, Preparation of Solid Waste Management Measures in Pazardjik, Pleven and Vidin Regions – Bulgaria, EuropeAid 117409/D/SV/BG.

The Excel tool allows an analysis to be performed both with a future shifting composition of the generated MSW, or without such a shift, with respect to the actual composition.

Future waste generation, by waste fraction, is reported in percentages and in quantities for all years between the basic year and the target year.

Overall, the baseline scenario should provide projections for:

- waste generated
- waste collected
- collected and dumped
- collected and landfilled
- collected and incinerated
- collected and recycled
- collected and composted

Step 3. Target to be used

The primary scope is to avoid non-controlled waste dumping, and to replace it with sanitary landfills. Supplementary targets have been defined, based on European Union targets for recycling of specific waste fractions, and for landfill diversion of biodegradable waste. The recycling targets are applicable on the amount of waste being generated in the target year and the landfill diversion target, to be reached in the target year, is based on a percentage of biodegradable waste being generated in the basic year. As for waste collection, the target year is best set relatively far in future, because of the ambitious character of the targets. In the ENPI study the target year was 2030, but this assessment calculated the degree to which these targets would be achieved by 2020 to make the analysis comparable with the other parameters (whose target year was 2020).

The recycling and landfill diversion targets are inspired by the targets included in the Waste Framework Directive of the European Union.

There are two kinds of EU targets:

- The recycling targets are anchored to a target year (2020 for the European Union, but 2030 in this project) and require that 50 per cent of a certain waste material generated in the target year is recycled in this target year.
- However, the EU landfill diversion target is much more permissive. In the EU the total amount of biodegradable waste landfilled in the years 2006, 2009, 2016 (or 2010, 2013, 2020) must not be above 65 per cent, 50 per cent, and 35 per cent of the total amount of biodegradable waste generated in 1995. This philosophy was kept in the ENPI study. The proposed target requires that the amount of biodegradable waste landfilled in the countries in the target year would not be higher that 35 per cent of the amount of biodegradable waste generated in the basic year. Of course, just as in the EU target, an increase of total waste generation is not taken into account, as the target refers to an absolute 'historic' value and not to a relative percentage.

Key targets used:

- 50 per cent recycling of generated plastic waste, paper, metals and glass by the target year (here: 2030) compared to the reference year (here: 2008)
- 65 per cent landfill diversion of biodegradable waste by the target year. Biodegradable waste is considered the sum of organic + paper + textile waste.

The diversion of biodegradable waste can be calculated by looking at the generation of bio-waste, paper and textile in the basic year.

Due to lack of consistent data, no 70 per cent recycling target for construction and demolition waste (of municipal origin) was taken into account in the ENPI study.

The Excel tool allows the proposal of percentages for recycling, landfilling, incineration, recycling and composting and reports if the targets for the minimum quantity for recycling, the maximum quantity still allowed on landfills, and the minimum quantity to be composted are reached. Biodegradable waste diverted from landfills must be composted, except for the fraction of paper that can be recycled.

By adapting the values in the yellow boxes in the Excel tool until targets are reached, a target compliant scenario can be defined. Check on the right hand side the distance-to-target.

Rationale: increasing waste treatment leads to societal benefits in the fields of environmental and health impact reduction, resource savings and job creation.

Step 4. Assess the environmental improvements

The environmental benefit consists of avoided dumping and increased recycling or composting of waste.

A linear evolution from the basic year towards the target year is assumed.

The environmental improvements in the benefits year (here: 2020) can be calculated by assessing:

- The amount of waste not being dumped in uncontrolled dumpsites - this is the difference between the amount dumped in the baseline scenario for the benefits year and the amount of waste still dumped in the target compliant scenario in the benefits year. Waste dumped is calculated as the sum of waste collected and dumped, and waste not collected at all and presumed dumped.
- The amount of waste additionally composted or recycled. The environmental improvement consists of the amount of waste which will be composted or recycled, compared to the amount that would already be composted or recycled in the baseline scenario.

Step 5. Assess the benefits

Most of the benefits will have to be assessed in qualitative terms, some of them in quantitative term and, if data allows, in monetary terms. An overview is provided in the following table, and the methodology for each type of assessment is explained below.

Table 7.10. Overview of the scale of the assessment: qualitative, quantitative and monetary analysis of benefits

Benefits	***Qualitative***	***Quantitative***	***Monetary***
Health	*YES*	*NO*	*YES*
Environmental	*YES*	*YES*	*YES*
Economic	*YES*	*YES*	*YES*
Social	*YES*	*YES*	*YES*

Qualitative assessment

Describe the benefits in qualitative terms. An overview of key benefits from improved/increased waste collection is provided in the table below. Through interviews and literature research, the following should be further developed and tailored to the country specific/local situation.

Table 7.11. Overview of key benefits

Health benefits	Health benefits related to avoidance of pollution of soil, ground water and air due to substandard treatment
Environmental benefits	Improved landscape, avoided pollution
Economic benefits	Increased availability of secondary raw materials, potential for electricity generation (energy cell, incinerator or waste to energy)
Social benefits	Possible job creation in waste treatment industry

Quantitative assessment

- **Economic benefits (Job creation** *(also social benefit)***)**

The number of employees needed for shifted waste treatment options can be assessed as follows (EuropAid, 2009):

- An average landfill with a capacity up to 1,000,000 tonnes requests 1 chief, 4 porters, 1 compactor driver, 1 bulldozer driver, 1 excavator driver, 1 driver, 1 pump operator, 1 maintenance technician and 1 weighing pond operator = 12 jobs
- The conservative estimation that incineration generates twice as much jobs than landfilling should be applied
- Job potential in the recycling industry is very diverse, and an average is not estimated. A conservative assumption is that it will not require fewer employees to recycle than to landfill.
- The number of employees for a straightforward windrow composting plant of 20,000 tonnes/year requests 5 jobs

The average number of employees for each treatment technique can be adapted to local conditions.

When applying these assumptions on the amounts of waste treated, the total number of supplementary person-years of jobs created can be calculated.

Monetary assessment

- **Overall benefits of improved waste management**

It is assumed that any household not receiving waste collection services will be willing to pay 1 per cent of their income for waste management, including both collection and safe treatment of the waste. EPTISA quotes an affordability threshold of 1 per cent of average household income but it should be taken into account that in reality for the poorest 10 per cent of households waste collection and treatment can account for as much as 5 per cent of household income due to the uniform fixed price structure of waste charges (IPA et al, 2007). In this study we will respect the EPTISA 1 per cent threshold value as a realistic WTP for waste collection and treatment.

The monetary value of extended waste collection coverage can thus be calculated using the willingness-to-pay (WTP) value for waste collection, based on the amount of people additionally covered with waste collection and management services in the year the benefits needs to be assessed (here: 2020).

Willingness to pay percentage and average income can be adapted to local conditions. We may assume that people additionally served with waste collection will be predominantly rural people, with a lower than average income.

- **Economic benefits (Job creation)**

If data on average wage are available in the country under analysis (see Table 8.2), this can be multiplied by the total person-years of jobs as calculated above, to estimate the total value of supplementary generated wages. We include employment benefits under economic benefits, but clearly these are also social benefits; one category does not exclude the other.

7.2.2 Methane emissions from waste

<u>Definition of the parameter</u>

This parameter includes methane emissions from landfill, divided into released and captured emissions. Captured landfill gas can be measured or the capacity of the capture installations can be assessed. Released landfill gas has to be assessed from the quantity of waste being landfilled, using general calculation rules.

Methane is generated by waste that is:

- Not collected and presumed illegally dumped, buried or combusted
- Collected and dumped in non-controlled dumpsites

- Collected and landfilled in controlled landfills

Rationale for choice: When biodegradable waste is landfilled or dumped, anaerobic conditions may be created in which the waste starts to decompose by bacterial activity, generating, amongst other emissions, methane and CO_2. These greenhouse gases contribute to global warming.

Methane is 21 times stronger as a greenhouse gas than CO_2. Landfilling of waste contributes ~30-35 Tg methane annually to the world's total methane emission of ~550 Tg/yr (Matthews and Themelis, 2007). Therefore harvesting methane and releasing it as CO_2 - either by flaring, by stabilising waste before landfilling, or by gaining energy from landfill gas - can be a strong measure for global warming remediation.

Socioeconomic benefits are to be found in reduced global warming, reduced environmental and nuisance impact and in the use of landfill gas as an additional energy resource.

Methodological steps

Data needs: see tables 8.1-5 above and data checklist in Annex VI.

Step 1. Describe the state of the environment (at reference point: e.g. 2008 and/or most recent year available)

- Describe the number and capacity of landfills with landfill gas capture infrastructure, and calculate or assess the quantity of landfill gas being captured.
- Take from the parameter 'waste treatment data' the amount of waste being landfilled or dumped after collection.
- Take from the parameter 'waste collection coverage' the amount of waste generated.

Geographical coverage: the whole territory of the country.

Step 2. Define the baseline in time period of interest (e.g. 2020)

The landfill gas emissions in the baseline scenario is derived from an assessment of the total amount of waste landfilled, dumped or not collected in the target year, as calculated in chapters 8.1.1 and 8.2.1.

The difference between both scenarios shows the amount of landfill gas emissions that can be additionally avoided. The socio-economic benefits can be expressed in the market values of avoided CO_2 equivalents (methane converted by the relative global warming potential).

Step 3. Target to be used

The landfill gas emissions in the baseline scenario and in the target compliant scenario in the benefits year (e.g. 2020) are derived from an assessment of the total amount of waste landfilled, dumped or not collected. In the target scenario we additionally assume that a percentage of all methane from landfills will be captured with landfill gas collection equipment. This percentage has to be between zero and the technical maximum achievable level of 50 per cent.
The difference between both scenarios shows the amount of landfill gas emissions that can be additionally avoided. The socioeconomic benefits can be expressed in the marked values of avoided CO_2 eq.

Step 4. Assess the environmental improvements

The total amount of waste which ends up either in a dumpsite or a landfill is counted together, both for the baseline scenario and for the target compliant scenario. For this dumped or landfilled waste, the expected methane genesis is assessed and converted into CO_2 eq. Methane has a global warming potential (GWP) of 25 for 100 years[28] (Foster et al., 2007), which means that one kg methane has the same global warming effect of 25 kg CO_2.

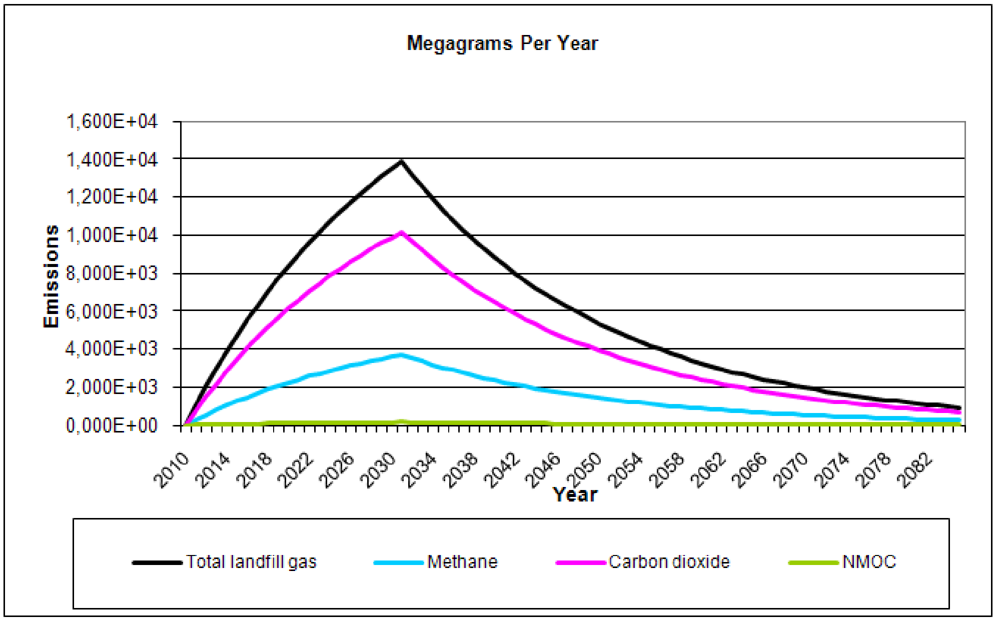
The model of the EPA (United States Environmental Protection Agency) - LANDGEM[29] - is used to assess the total emissions of landfill gas and of methane from a standardised landfill of 1,000,000 tonnes with a yearly input of 50,000 tonnes and a lifetime of 20 years. This can be a proxy for overall landfill emissions.

Total methane emissions are assessed at 170,164,940 m³ of methane emissions over the whole lifespan of the landfill plus its after-phase (see figure below). This can be translated in a ratio of 170 m³/tonne landfilled MSW. The same ratio is used for dumpsites, although the methano-genesic processes may be different due to different environment conditions and the effect of frequent fire incidents.

28 Whilst CO_2 has a GWP of 1 for 100 years

29 Landfill Gas Emissions Model (LandGEM) Version 3.02 on http://www.epa.gov/ttn/catc/products.html#software

Figure 7.2 Gas emissions over the lifespan of a landfill



For the target compliant scenario an adaptable degree of methane capture at landfills is assumed.

The environmental improvement is the amount of avoided methane emissions in the target scenario, compared to the baseline scenario. This can be calculated using the above mentioned standard values and the amounts of waste not-collected, dumped and landfilled as calculated in chapters 8.1.1 and 8.2.1.

Step 5. Assess the benefits

Most of the benefits will have to be assessed in qualitative terms, some of them in quantitative term and, if data allows, in monetary terms. An overview is provided in the following table, and the methodology for each type of assessment is explained below.

Table 7.12. Overview of the scale of the assessment: qualitative, quantitative and monetary analysis of benefits

Benefits	***Qualitative***	***Quantitative***	***Monetary***
Health	*YES*	*NO*	*NO*
Environmental	*YES*	*YES*	*YES*
Economic	*YES*	*NO*	*NO*
Social	*YES*	*NO*	*NO*

Qualitative assessment

Describe the benefits in qualitative terms. An overview of key benefits from reduced methane emissions from waste is provided in the table below. Through interviews and literature research, the following should be further developed and tailored to the country specific/local situation.

Table 7.13. Overview of key benefits:

Health benefits	Health benefits will be mostly related to reduced climate change impacts (see 'Climate change' theme related benefits). Further local benefits are possible (e.g. increased level of health and safety in waste treatment plants etc.).
Environmental benefits	Environmental benefits will be mostly related to reduced climate change impacts (see 'Climate change' theme related benefits) in terms of reduced CO2 emissions. Further local benefits are possible.
Economic benefits	Beside reduced damages from climate change impacts (see 'Climate change' theme related benefits), economic benefits will also be related to the use of the captured methane for energy production.
Social benefits	Local improvements related to reduced climate change impacts (see 'Climate change' theme related benefits) and improved waste treatment plants (e.g. reduced odours etc.).

Quantitative and Monetary assessment

- **Environmental benefits**

The environmental benefits are linked with the market value (under the international CO_2 eq. emissions trading system) of avoided CO2 eq. emissions. The carbon values used in this study have a range of €39 /tonne to €56 /tonne for 2020. This can be adapted to other values or another benefits year.

In calculating the benefits, the density of methane of 0.68 kg/m³, the conversion factor of 25 between methane and CO_2 eq and the average emission of m³ methane per tonne waste landfilled can be used.

The Excel tool gives a benefits value range in Local Currency Units (LCU) and Euro for the ENPI countries, corresponding to the calculated quantity in m³ of avoided methane emissions between baseline and target compliant scenario.

8 METHODOLOGY FOR ASSESSING NATURE RELATED BENEFITS

This part of the analysis encompasses the benefits stemming from improved nature conservation including increased protection of areas rich in biodiversity (e.g. improved conservation status and protected area size, increased protection of species etc.) and the reduced pressures on the natural environment (e.g. to reduce soil erosion, deforestation etc.)

The theme covers the following subthemes and parameters:

- Sub-theme: Biodiversity
    - Parameter: Level of biodiversity protection
- Sub-theme: Sustainable use of natural resources
    - Parameter: Deforestation
    - Parameter: Level of cropland degradation
    - Parameter: Level of rangeland degradation

Both sub-themes include consideration of the cross-cutting issue of Climate Change, specifically mitigation and adaptation to climate change.

The overall assessment in relation to Nature focuses on the status of current natural capital, in particular on the loss of important biodiversity/natural assets - and how this affects species populations, the availability of natural resources and ecosystem services and society's natural heritage - and on the benefits that accrue to society from increasing nature protection. To assess this information is needed, for example, on the protected area network (number of sites, area and level of protection etc.), on key ecological infrastructure and services (existence, extent, quality and functioning of key ecosystems and key ecosystem services such as water purification and provision from forests/wetlands, carbon storage etc.), on rangeland and on issues such as soil erosion and salinity. Information on the threats to and drivers of change in the level of species and habitats is also needed, together with data on the level of tourism and the revenue it generates, and the recreational use of nature.

8.1 Sub-theme: BIODIVERSITY

Biodiversity does not just relate to species, but also includes genes and ecosystems. The Convention on Biological Diversity (CBD)'s widely accepted definition states that '*Biological diversity means the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems'*. A BA study should therefore consider these three key biodiversity components, although in practice the focus will need to be on species and ecosystems.

Strictly speaking, biodiversity is the variability amongst such components but the term is commonly more widely interpreted as incorporating abundance parameters. Hence the study should also consider biodiversity losses with respect to declines in biological populations and ecosystem extent, as well as losses of distinct forms of species and ecosystems.

This accords with the increasing recognition that biodiversity has a wider importance beyond traditional nature conservation concerns, in terms of providing a wide range of socioeconomic benefits. Recent studies such as the Millennium Ecosystem Assessment (MEA, 2005) and The Economics of Ecosystems and Biodiversity (TEEB, 2008, 2009, 2010 and 2011) have clearly demonstrated that biodiversity underpins the delivery of all such ecosystem services.

8.1.1 Level of biodiversity protection

<u>Definition of parameter</u>

The parameter measures the share of terrestrial and marine protected areas in relation to land and sea area. The proportion of land designated as protected areas is used here as an indication of how much biodiversity is protected in the country. It should be noted though that even if an area is formally protected, this does not imply that the level of protection/management is sufficient to adequately preserve biodiversity. Therefore, insights on the quality of protected areas will also be needed in order for the parameter to be a meaningful measure.

The following definitions apply:

- *Protected areas:* A clearly defined geographical space which is recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values (Dudley, 2008).

  Protected area management categories also relate to those as defined by IUCN (see Dudley, 2008 for details), namely:

- CATEGORY Ia: Strict Nature Reserve: protected area managed mainly for science
- CATEGORY Ib Wilderness Area: protected area managed mainly for wilderness protection
- CATEGORY II National Park: protected area managed mainly for ecosystem protection and recreation
- CATEGORY III Natural Monument: protected area managed mainly for conservation of specific natural features
- CATEGORY IV Habitat/Species Management Area: protected area managed mainly for conservation through management intervention
- CATEGORY V Protected Landscape/Seascape: protected area managed mainly for landscape/seascape conservation and recreation
- CATEGORY VI Managed Resource Protected Area: protected area managed mainly for the sustainable use of natural ecosystems

These can be managed privately, by governments, or have shared governance potentially also involving community management.

- *Important Bird Areas (IBAs):* IBAs are key sites for bird conservation that have been identified by national experts according to standardised criteria developed by BirdLife International[30]. They do one (or more) of three things: hold significant numbers of one or more globally threatened species; are one of a set of sites that together hold a suite of restricted-range species or biome-restricted species and/or have exceptionally large numbers of migratory or congregatory species. Identification as an IBA does not give any protection in itself however, many are, or become protected areas.

Unit of measurement (indicators):

1) Proportion of terrestrial area protected
2) Proportion of terrestrial area protected excluding agricultural areas other than permanent pastures and meadows[31] (in order to correct for countries that have large areas of agricultural habitats that are unlikely to be of high conservation value)
3) Proportion of marine area (up to 12 nautical miles) protected
4) Proportion of terrestrial area and marine area (up to 12 nautical miles) protected (1+3)
5) Proportion of total IBA area that is protected

Rationale for choice: The proportion of land designated as protected areas (in accordance with IUCN definitions) is a widely used indicator of measures used to conserve biodiversity, and is for example included in the CBD set of biodiversity indicators[32] and the SEBI (Streamlining European Biodiversity Indicators) set used in

30 http://www.birdlife.org/action/science/sites/index.html

31 According to FAO data

32 CBD biodiversity indicators

the EU[33]. This is because protected areas are a key instrument used to conserve biodiversity and reasonably comprehensive and standardised data exist for most countries on national protected area designations, which have been compiled in a central World Database of Protected Areas (WDPA)[34].

However, it is important to note that the percentage of a country designated as protected areas does not provide a reliable indication of the adequacy of the proportion protected (as this will vary according to the ecological/biodiversity value of the country), the ecological coherence of the protected areas as a network, the level or effectiveness of protection given to biodiversity within protected areas, or the degree to which positive management measures are undertaken within them. Also many countries have important biodiversity resources outside their protected area networks, which may be conserved to varying degrees through various instruments in the wider environment.

To attempt to control for some of these constraints, the basic measurements of proportion of land and sea areas protected (as listed above) are supplemented by two other measurements for comparative proposes. Firstly, by excluding low biodiversity value habitats (e.g. agricultural habitats) from the measurements (point 2 above). Secondly, the proportion of IBA area that is protected is assessed (point 4). These measures are identified using common criteria and standards and therefore provide a more reliable basis for identifying protection needs. Although IBAs are only identified on the basis of bird data, they often provide wider biodiversity benefits and can therefore be used as a relatively representative indicator of biodiversity protection.

Methodological steps

Data needs: see data checklist in Annex VI.

Step 1. Describe the state of the environment (at reference point: e.g. 2008 and/or most recent year available)

Describe the current state of biodiversity – e.g. the protected areas, the species at risk, key habitats/ecosystems/biomes and key relationships with land use (e.g. agriculture and biodiversity). This should provide a recognisable picture of the country and identify the key issues of importance for the country. It should also provide a solid quantitative and qualitative basis, understanding, and should also include maps.

In particular, provide a brief overview of:

33 http://biodiversity-chm.eea.europa.eu/information/fol168004

34 http://www.wdpa.org/

General description: why is the country important for biodiversity e.g. due to climatic zones/conditions, biogeographic position, unique physical features e.g. presence of a particular river, mountain chain, sea etc. Include comments for terrestrial, freshwater and marine habitats.

Key ecosystems: Describe each broad ecosystem/habitat types present in the country (see example for Egypt below).

Example of Biodiversity Elements in Egypt for discussion
1. Coastal and marine biodiversity
2. Inland waters and wetlands
3. Dry and sub-humid lands
4. Agro biodiversity

Source: Egypt State of Environment Report, 2008.

Provide data/information that will be crucial for conducting the assessment (priority information) as well as some that will be important but less essential (desirable information) and some optional data that can provide some contextual information and should be gathered if data are easily available (optional information). These are listed below:

Priority information:

- Scale and location – ideally provide a national map noting the main ecosystems and locations of sites and features mentioned in the accounts
- Lists and descriptions of key features of biodiversity importance, e.g. habitat types of particularly high biodiversity importance (e.g. as identified in a Biodiversity Action Plan (BAP)), populations of globally threatened species (i.e. IUCN Red Listed), nationally rare/endemic/threatened species (e.g. BAP listed), internationally important populations of migratory species
    - Number and area of each protected area type (according to IUCN typology)
    - Number and area of IBAs (by category) and proportion of area that is protected. Insights on the adequacy and coherence of the protected area network and the effectiveness of its protection and management
    - Number of species identified nationally as rare/endemic/nationally important
- Particularly important sites for threatened habitats and species and sites that hold internationally important populations of species (over-wintering, migratory staging posts or breeding). Ideally note which sites are protected e.g. as Ramsar sites, World Heritage sites etc.
- Insights on the importance of biodiversity outside protected areas and effectiveness of conservation measures in the wider environment (it will be important to know whether there are other areas outside of protected areas designation that have the potential to be designated in light of their biodiversity heritage)
- List and, if possible rank, the principal past, current and future threats to overall biodiversity within and outside protected areas (e.g. overfishing, invasive species, visitor damage, deforestation, overgrazing etc.) using the

IUCN threat typology[35]. Describe the most important threats and their drivers. The aim is to get an understanding of the threats and their importance/scale; again this cannot be an in-depth analysis.

- The protection mechanisms given to different PA types (e.g. from state ownership and strict legal protection, to consideration in planning decisions and management of each PA type from state/conservation organisation ownership).
- Management planning procedures in PAs; what % of PAs have completed management plans.
- Any assessment of the effectiveness of PA management (if existing).
- Overview on IBAs (size, level of protection, main characteristics etc.) – information can be obtained e.g. by contacting the national BirdLife organisation.

Desirable information:

- Important ecosystem services associated with a particular habitat - especially provisioning (food, fuel, fibre), regulating (water, carbon, soils, flood control) or cultural/amenity services - and the elements of society that depend on/ are affected by them. This will not be possible to do systematically for the country apart from at a very broad level, so a general overview complemented by some case examples would be appropriate;
- Information on the coherence of the protected area network, for example, whether they form part of an ecological network;
- Measures that are used to support environmentally friendly management within PAs and in the wider environment e.g. from equivalent to agri-environment measures in the EU, to purely voluntary/guidance measures etc.;
- Spending levels on nature conservation, both within and outside of protected areas;
- National targets for protected areas coverage (if possible distinguishing between terrestrial and marine ecosystems);
- People employed in nature conservation activities (in full time equivalents) and eco-tourism related activities;
- Number of tourists per year in protected areas/natural parks, and;
- Revenue from visitors/tourism to nature conservation sites and/or average entrance fee, plus other revenues from nature conservation

Optional information: *(this will be useful for a possible Institutional Assessment, but useful here too to understand whether the level of management is adequate):*

- The development of any Biodiversity Strategy for the country and Biodiversity Action Plans e.g. for threatened habitats and species; biodiversity targets arising from such plans, implementation mechanisms (e.g. funding, governmental support), monitoring and reporting procedures on BAPs, achievements so far etc.;

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35 http://www.birdlife.org/action/science/sites/index.html

- Other measures to protect or restore threatened species or habitats;
- Consideration of biodiversity in EIA and SEA processes and whether there are no-net-loss policies and compensation requirements, and;
- Monitoring and reporting on the state of biodiversity.

Geographical coverage: Preferably national level, or regional level if data are not available; local examples (e.g. a protected area) can be used to further illustrate the case, if relevant.

Summary of key data needs (see also data checklist in Annex VI):

Priority information:

- Number and area of each protected area type (according to IUCN typology)
- Number and area of IBAs (by category) and proportion of area that is protected. Insights on the adequacy and coherence of the protected area network and the effectiveness of its protection and management
- Number of species identified nationally as rare/endemic/nationally important
- % of PAs that have completed management plans
- Protected area data (from WDPA)
- Land use data (from FAO)

Desirable information:

- National targets for protected areas coverage (if possible distinguishing between terrestrial and marine ecosystems)
- People employed in nature conservation activities (in full time equivalents) and eco-tourism related activities
- Number of tourists per year in protected areas/natural parks
- Revenue from visitors/tourism to nature conservation sites and/or average entrance fee, plus other revenues from nature conservation

Step 2. Define the baseline in time period of interest (e.g. 2020)

The specific focus of the benefits assessment on biodiversity is on the comparison of the 2020 target to the 2008 reference year. In other words, the baseline is not considered here as a critical issue for the assessment of the benefits.

The PA data are unlikely to show reliable trends as PA numbers in database are more likely to reflect trends in reporting than actual PA designation. However, if qualitative insights are available (from the literature or through interviews) on the expected development of protected areas (e.g. increase/decrease in size, level of degradation, species/habitat losses etc.), this should be noted in the report. Although this will not be a formal baseline, it will indicate whether the 2008 reference year is a good comparison point, and if the target is a realistic one (see also point 3 on the target).

Step 3. Targets to be used

The CBD Strategic Plan for 2011-2020 includes a target for protected areas (see below) that at least 17 per cent of terrestrial and inland water and 10 per cent of coastal and marine areas (if applicable) are conserved through effective management practices. This was used as the target for the ENPI study.

However, it is important to note that each country has a different natural heritage and a different potential/need for protected area coverage. In the ENPI study, to allow comparability, a common target was used for all countries as a first point of assessment, but comparisons with national targets were taken into account if possible/existing (e.g. if included in national Biodiversity Action Plans). In general, some commentary on the adequacy of the protected area network should be included based on, for example, IBA protection levels, published studies of protected area needs or consultations with national conservation organisations.

Rationale: This is the CBD target for global PA coverage to which several countries have signed up to in Nagoya 2010 (see box below). It should be noted, however, that this may or may not be in line with national targets, and that the latter are more likely to take into account the biodiversity importance of the country and the need for protected area designations. The target proposed here is therefore more a tool to allow comparability across the country studies, rather than an appropriate target for the specific country under analysis.

Box 8.1 CBD Strategic Plan 2011-2020

Strategic goal C: *To improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity*

Target 11: By 2020, at least 17 per cent of terrestrial and inland water and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscape and seascapes.

This is a global target and no specific national ‘target effort sharing’ has been elaborated.

Step 4. Assess the environmental improvements

The environmental improvement is based on the increase in PA designation if the CBD Strategic Plan target and/or national target are achieved.

The current level of areas protection should be expressed:

- as a percentage of total terrestrial area
- as a percentage of total terrestrial area (excluding agricultural areas other than permanent pastures and meadows[36]); this will make it possible to

[36] According to FAO data

correct for countries that have large areas of agricultural habitats which are unlikely to be of high conservation value

The improvement will be represented by the difference between the percentages above and the target percentage (17 per cent). Insights on the appropriateness of this target, in light of actual national biodiversity conditions and targets, should be duly noted.

Step 5. Assess the benefits

Most of the benefits will have to be assessed in qualitative terms, some of them in quantitative term and, if data allows, in monetary terms (and here likely to be on local case examples or specific biomes (e.g. coral reefs) where a study has already been done, or for a small subset of issues (e.g. tourism revenue related to protected areas). An overview is provided in the following table and the methodology for each type of assessment is explained below.

Table 8.1. Overview of the scale of the assessment: qualitative, quantitative and monetary analysis of benefits

Benefits	*Qualitative*	*Quantitative*	*Monetary*
Health	*YES*	*NO*	*NO*
Environmental	*YES*	*YES if info available*	*NO*
Economic	*YES*	*YES if info available*	*YES if info available – case examples only, where existing reports*
Social	*YES*	*NO*	*NO*

Qualitative assessment

Describe the benefits in qualitative terms. An overview of key benefits from increased PA designation is provided in the table below. Through interviews and literature research, the following should be further developed and tailored to the country specific/local situation.

Table 8.2. Overview of key benefits

Health benefits	Green space for recreation and relaxation etc. with associated mental and physical health benefits Health benefits from clean air and water from intact ecosystems (overlaps with ambient air and water themes)
Environmental benefits	Safeguard species, especially threatened species and species that occur in internationally important numbers. Sustainable use of natural resources (vegetation, water, soils etc.) Maintain and enhance ecosystem services (water storage/purification, carbon storage, flood control etc.) Increased resilience to climate change/adaptation.
Economic benefits	Opportunities for eco-tourism, including revenue generation from tourism (entrance fees etc.) and job opportunities (paid or voluntary). Income generation from associated businesses – hotel, catering, B&B,

	recreation (mountain biking, walking, climbing etc.) Support for regional products (food, game etc.)
Social benefits	Amenity and recreation facilities. Opportunities for education and research. Increased public awareness of environmental issues. Enhancement of social values (e.g. iconic species, traditional lifestyles, valued landscapes and maintenance of 'a sense of place').

Quantitative assessment

The benefits will be highly dependent on the types of ecosystems that will be given added protection and their current status, biodiversity importance and threats to them. If data do not allow any quantification, some quantitative insights regarding recreation levels, tourism levels etc. may still be possible. Some specific quantitative insights relating to water provision, carbon storage and other ecosystem services may be noted if accessible studies exist for specific protected areas. These would provide useful local 'nuggets' of information to help create the overall picture of the level of the benefits.

Monetary assessment

Given that data on biodiversity monetary values are usually relatively scarce (this was the case in the ENPI countries for instance), monetary assessments may not be applicable for a country as a whole, with the exception, at best, of an assessment of the benefits of protected areas for tourism, providing information is available on existing reports. Also, when information is available on current revenues and employment related to protected areas (see section 1 on the state of the environment), it is worthwhile noting that if biodiversity is not protected (i.e. below the current level), these benefits will be lost.

Some local case examples with specific monetary insights will be useful to illustrate the case of the value of biodiversity. These may prove most useful to present an integrated picture of the benefits of biodiversity/protected area integrating qualitative, quantitative, spatial and monetary aspects. A wider range of ecosystem services can be addressed and help communicate the fact that protected areas, alongside their important roles vis-à-vis species and habitats, also offer not just tourism and recreation benefits, but also a range of ecosystem services such as water purification and provision, non timber forest products, flood control and climate regulation, to name but a few.

In summary, the BA should provide a broad national description and assessment, complemented by a few case examples to provide additional substance; together it should provide a good overall picture of the benefits of biodiversity.

Future country assessments could usefully go much further than has been possible in this project, and look at the extent and status of its natural capital, who the beneficiaries are, what benefits are currently obtained (e.g., through non-priced inputs to production, through wider ecosystem services valuation), what the areas at risk are (from land use change, degradation, including marine ecosystems) over what time, and assess the cost of policy inaction and/or benefits of action (e.g., restoration, investment in biodiversity including not just core protected areas but also wider green infrastructure). This would be an extensive and complex assessment but would fundamentally help ensure that 'natural capital' is seen on a level playing field with man-made capital and that nature's often free inputs to the economy and society are understood and taken up in decision making (see TEEB 2011). Some elements of this ambition to understand the value of our natural capital are demonstrated below in the themes of deforestation and cropland degradation.

8.2 Sub-theme: SUSTAINABLE USE OF NATURAL RESOURCES

This theme covers the sustainable use of natural resources and focuses in particular on forests, cropland and rangeland.

It should be pointed out that rangeland degradation was not explored in the ENPI study since FAO data suggested that the potential cost of rangeland degradation, and potential benefit of improvement, may be significant in only 4 out of the 16 countries under study (Jordan, Morocco, Syria and Tunisia). Therefore, for the sake of comparability, the analysis focused only on the parameters that were relevant for all, or most, of the countries under study. A methodology for the assessment of rangeland degradation was, however, developed for the study and is included in this BAM.

An Excel worksheet is provided in Annex VII to support the calculations for the 'Deforestation' parameter.

8.2.1 Deforestation levels

<u>Definition of the parameter</u>

This parameter measures the annual change in the area of forested land. Change is measured either as number of hectares (ha) increase or decrease in forested land or as percentage increase or decrease in the area of forested land (FAO, 2009, Annex II). The overall assessment of change should include both Forest Loss due to removal of trees and Forest Gain due to replanting. Note that a net zero loss in forest cover (replanting the same area as is deforested in a given year) may not necessarily lead to no net loss of value to the country, as the stock and flow of products and services from the lost forest and gained forest are often different. The Box below presents the global picture to present a context and introduction to the issue.

Box 8.2. Forests, forest coverage, benefits and deforestation

Forests of various forms cover an area of around 4 billion hectares[2] (30.3 per cent of total global land area) and contain 80 to 90 per cent of the world's remaining terrestrial biodiversity (Costanza et al, 1997, see also FAO, 2000). They provide many valuable goods and services including timber, food, fodder, medicines, climate regulation, provision of fresh water, soil protection, carbon storage and sequestration, cultural heritage values and tourism opportunities (Shvidenko et al, 2005).

It has been estimated that around 1.1 billion people depend on forests for their livelihoods (UN Millennium Project, 2005; Vedeld, 2004) and that 1.6 billion people around the world depend to some degree on forests for their livelihoods (World Bank, 2004).

FAO's most recent *Global Forest Resources Assessments* (FAO, 2010) reports the following findings:

- About 13 million hectares were converted to other uses or lost through natural causes each year in the last decade, with the highest net losses of forest reported for South America and Africa, with 4 and 3.4 million hectares respectively.
- The net loss of forest area was reduced to 5.2 million hectares per year between 2000 and 2010, down from 8.3 million hectares annually in the 1990s. The net annual loss of forests in 2000 to 2010 is equivalent to an area about the size of Costa Rica or Slovakia.

Source: ten Brink et al, 2011.

The following definitions apply:

- *Forest:* Land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 per cent, or trees able to reach these thresholds *in situ*. It does not include land that is predominantly under agricultural or urban land use (FAO, 2010).
- *Other Wooded Land:* Land not classified as 'Forest', spanning more than 0.5 hectares; with trees higher than 5 meters and a canopy cover of 5-9 per cent, or trees able to reach these thresholds *in situ*; or with a combined cover of shrubs, bushes and trees above 10 per cent. It does not include land that is predominantly under agricultural or urban land use (FAO, 2010).
- *Deforestation:* includes activities such as conversion of forest to agricultural land, conversion for urbanisation, illegal logging etc. Forest may also be degraded by fire, pests and storms which can lead to their eventual loss. When considering factors driving deforestation, the likelihood of these degradation factors increasing/decreasing should also be considered

Unit of measurement (indicator): number of hectares (ha) of forested land lost or gained in each year or percentage (%) of forested land lost or gained in each year (FAO, 2009 --Annex VI Table E).

Rationale for choice: Change in forest cover is an important global issue as deforestation can be a substantial source of greenhouse gas emissions and can also result in a loss of carbon storage and knock-on effects for soil quality and soil erosion. The issue of carbon storage and sequestration is gaining in global prominence with the increasing support for the REDD+ instrument (Reduced Emissions from Deforestation and Degradation) at international level (UNFCCC and UNCBD Conventions) and will lead to increasing market/payments for avoided carbon emissions. There are also a wide range of other benefits from forests as given in box 8.3 below which gives some examples from across the world as context for the current study.

Box 8.3. Examples of potential ecosystem service values from forests

The table below shows that forests can have significant value for regulating services even though their economic importance is often perceived only in terms of products (timber and non-timber). For instance, case studies on tropical forests show that it is not atypical for about two-thirds of forest value to derive from regulating services and only one-third from provisioning food, raw material and genetic material for pharmaceuticals. As noted earlier, there are very few valuation studies carried out in the ENPI region on the benefits of ecosystem services, hence the table below includes a number of examples from beyond the ENPI region.

Service	Value
Food, fibre and fuel	Provisioning services for Cameroon's forests (average annual per hectare values) estimated at US$ 560 for timber, US$ 61 for fuel wood and US$ 41–US$ 70 for non-timber forest products (NTFPs) (Lescuyer, 2007, based on a review of previous studies). 4,691 rupees/household/year from NTFPs in Rajiv Gandhi National Park (Ninan et al., 2007)
Climate regulation	Value of climate regulation by tropical forests in Cameroon at US$ 842–US$ 2,265 per ha (Lescuyer, 2007, based on a review of previous studies). Value of carbon stored in above-ground biomass in Guyana's forests, estimated at US$ 6,500 to US$ 7,000 per ha at US$ 20/ton, but could rise to over US$ 20,000 per ha at potential values of US$ 60 - US$ 80/ton in near future. (Office of the President Republic of Guyana, 2008)
Water regulation	Value of flood protection by tropical forests in Cameroon estimated at US$ 24 per ha/year (Yaron, 2001).
Groundwater recharge	Contribution to groundwater recharge of a 40,000 ha tropical forest watershed in Ko'olau, Hawaii, estimated (Net Present Value (NPV) using shadow prices) at US$ 1.42–US$ 2.63 billion (Kaiser and Roumasset, 2002).
Pollination	Average value of pollination services provided by forests in Sulawesi, Indonesia, are estimated at € 46 per hectare. Due to on-going forest conversion, continued decline of pollination services is expected to directly reduce coffee yields by up to 18 per cent and net revenues by up to 14 per cent in the next 20 years (IESS et al., 2007).

Source: ten Brink et al., 2011 in TEEB 2011. Table 1.1 page 28

Methodological steps

The detailed steps are described below. An Excel worksheet is provided in Annex VII to support the calculations.

Data needs: see data checklist in Annex VI.

Step 1. Describe the state of the environment (at reference point: e.g. 2008 and/or most recent year available)

Describe the current state of forested land. In particular, provide a brief overview of:

- Different types of forest present in the country (primary forest, naturally regenerated forest or planted forest), their designated function (timber production, protection of soil and water, conservation of biodiversity, social services, multiple use etc.) and special designation or management category (area of permanent forest estate, area within protected areas, area under sustainable forest management, area with management plan etc.) (FAO, 2010);

- Total area (ha or km^2) of land or percentage of country/region under forest;
- Present an overview on the key threats to native forest e.g. from timber exploitation, pests and disease, fire, land conversion;
- Note the area or proportion of forest deforested each year i.e. forest removed and land abandoned or converted to other uses e.g. urbanisation, farmland, recreational land, abandoned (see national data and FAO);
- Ideally also present the area or proportion of forest degraded each year due to fire, pests and disease, over-grazing, timber exploitation (including illegal logging) etc. (if data are available), and;
- Examples of existing values from forests in the country under assessment, from national or international literature (see e.g. www.teebweb.org). These may be national or local examples and may cover one or more of the benefits streams noted above.

Geographical coverage: data should be collected at the national level and at regional and local level, particularly where there is forest loss (and gain). Some local case examples could also be useful where these are linked to measures of benefits from forested land.

Summary of key data needs (see also data checklist in Annex VI):

- Total land area (in 1000's ha)
- Population data: total no., density/km^2, % annual growth rate, rural population size as % of total (all data for 2004 and/or 2006)
- GDP: per capita (US$) and % annual growth rate
- Total area and (if possible) distribution of forest and other wooded land in the country – if possible differentiate between different FAO forest categories (see above). Ideally also present a map.
- Designated functions of forest (either legally or by landowner): classified as % under production, % protection, % conservation, % social services, % multi-purpose, % none/unknown
- Forest characteristic in 2005: as primary, modified natural, semi-natural, productive plantation, protective plantation
- Estimate of the area of land that has been deforested to date – ideally present a time series (ideally last 10 or 20 years), a historical context (e.g. what was the cover 50, 100 years ago), and what has been the most recent rate of deforestation
- Estimate of annual rate of deforestation and if possible forest degradation – in the last ten years. This can provide a useful historical rate to project into the future (unless strong evidence suggests otherwise; see baseline discussions).
- List of drivers / factors that bring about deforestation, including:

- Drivers directly affecting deforestation (i.e. through conversion of forested land to another land use) with, if possible, a qualitative (i.e. which drivers are the most important) and even quantitative estimate (i.e. what % are they responsible for) of the contribution of each driver/factor to the annual loss of forest land. If annual figures are not available, then give figures for a known time period.
- Drivers leading to forest degradation (e.g. wild fires, pests and/or disease outbreaks) with, if possible, qualitative and even quantitative estimates of the contribution of each driver/factor to loss of forest health and loss of forest area either annually or over a period of years.
- Information on trends in drivers of deforestation e.g. demand for agricultural land, future trends in urbanisation etc*.* and trends in drivers of forest degradation*.*

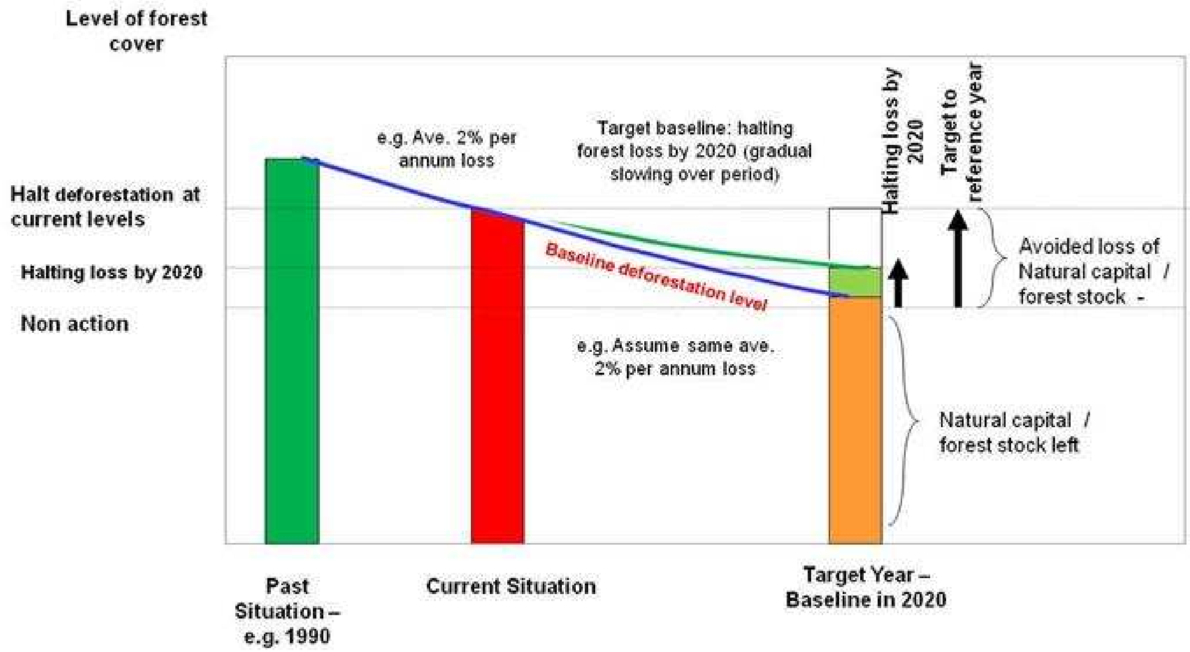
Step 2. Define the baseline in time period of interest (e.g. 2020)

The Excel work sheet provided allows calculation of the baseline in 2020, assuming that the trend in deforestation (or afforestation) will be linear. This basically is a projection for past trends based on FAO data, though national studies can explore variants if there has been a recent clear change of forest cover. The baseline also includes carbon values changing from 2010 to 2020 as noted earlier.

Step 3. Target to be used

The target is to halt deforestation by 2020. The BA should compare the 2020 forest cover under this target with what would have occurred in 2020 under a scenario of business as usual, as well as comparing the 2020 forest cover with current level to show what is being lost. See the figure below. Note that a gradual slowing of deforestation will still lead to loss over the period 2010 to 2020. A variant of 'halting forest loss at today's levels' can also be calculated to communicate the benefits of action. Note that, for some countries (indeed nearly all countries in ENPI South), there is net afforestation – here ideally one would split the deforestation and the afforestation and treat these separately, given the difference in value between old growth / existing forests and new forest cover.

Figure 8.1. Deforestation baseline level and target



Rationale: The halting deforestation target relates to the more ambitious end of the CBD COP10 global target. It also relates to the EU proposal[37], set out in Communication COM (2008) 645 final, made to UNFCCC concerning global deforestation and the challenge of limiting global warming within the bounds of 2^{o} C. This Communication proposes an objective of 'halting global forest cover loss by 2020 at the latest'. See the box below for details on the CBD targets related to forestry.

Box 8.4. CBD Strategic Plan 2011-2020: Targets linked to forestry

Strategic goal C: To improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity

Strategic goal B: Reduce the direct pressures on biodiversity and promote sustainable use

Target 5: By 2020, the rate of loss of all natural habitats, including forests, is at least halved and where feasible brought close to zero, and degradation and fragmentation is significantly reduced.

Target 7: By 2020 areas under agriculture, aquaculture and forestry are managed sustainably, ensuring conservation of biodiversity.

Strategic goal D: Enhance the benefits to all from biodiversity and ecosystem services

Target 14: By 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable.

37 EC COM(2008) 645 final 'Addressing the challenges of deforestation and forest degradation to tackle climate change and biodiversity loss'.

Step 4. Assess the environmental improvements

The environmental improvement arising from a change in the level of deforestation is given by the difference between the target area of forest present in the year 2020, and the total area of forest present in 2020 if baseline levels of deforestation continue. As noted above, this is a simplification (and should be seen as a starting point), as forest loss and forest gain are not equivalent in value. For example for the issue of carbon storage, a loss of 1 hectare of forest corresponds to the loss of the stock of carbon in the living carbon (the tree), the loss of a flow of annual sequestration by the vegetation on that hectare into the future, and eventually additional emissions from the loss of soil (dead) carbon. A new hectare of forest would only have the carbon storage gain in the first year (i.e. no stock), and then grow over time. The net present carbon store will be quite different.

Furthermore, given that there is no net deforestation in a number of countries in the ENPI region, the assessment of environmental improvements also includes an assessment of the amount and value of the carbon stored in the existing stock. This is not an improvement as such, but is useful to note to help communicate the importance of the standing forests.

This can be calculated using the Excel worksheet provided in Annex VII.

Step 5. Assess the benefits

Most of the benefits will have to be assessed in qualitative terms, some of them in quantitative term and, if data allows, in monetary terms. An overview is provided in the following table, and the methodology for each type of assessment is explained below.

Table 8.3. Overview of the scale of the assessment: qualitative, quantitative and monetary analysis of benefits

Benefits	*Qualitative*	*Quantitative*	*Monetary*
Health	*No (or limited)*	*NO*	*NO*
Environmental	*YES*	*YES*	*YES*
Economic	*YES*	*Only if info available*	*Only if info available*
Social	*YES*	*NO*	*NO*

Qualitative assessment

Describe the benefits in qualitative terms. An overview of key benefits from reducing the level of deforestation is provided in the table below. Through interviews and literature research, the following should be further developed and tailored to the country specific/local situation. This should present insights on the current level of benefits – i.e. the area potentially at risk from deforestation and degradation – and expected losses under the no action scenario and under the scenario of halting forestry loss in 2020 – this has benefits vis-à-vis the baseline and the present.

Table 8.4. Overview of key benefits

Health benefits	Forests can promote health and well-being through their use for recreation and relaxation. Obtaining evidence for this benefit is likely to be difficult and thus may represent only a small section in the benefit assessment.
Environmental benefits	A number of environmental benefits are associated with forest land. These include provision of habitat for animal species diversity and ecosystem regulating services such as carbon storage, soil and water conservation, flood or avalanche control, slowing the rate of desertification and coastal protection. Establishing regional or national scale benefit estimates for these different services may be difficult but a case example for a particular region or locality could give a clear idea of their importance and potential value.
Economic benefits	Forests give rise to a number of provisioning services that generate wealth. Specific examples include the provision of timber, fibres, non-wood forest products such as gums/resins, honey/wax, dying and tanning products, bush meat and other foods, medicines. Economic benefits may also arise from carbon trading as increased forest area could enhance the carbon sink provided by the national forest area. The level of enhancement will depend on the type, age and additional area of forest conserved. Well managed forests can also attract visitors and hence increase revenues from tourism/recreation. Management of forest for amenity provision or biodiversity conservation may also generate employment opportunities.
Social benefits	Benefits here include provision of amenity for recreation, education, tourism, cultural and spiritual heritage.

For a wider discussion of benefits from forests see TEEB 2011, TEEB 2010 and MA 2005.

Quantitative assessment

The quantification assessment focuses on environmental benefits in terms of a reduction in the area deforested, the quantity of carbon captured by the existing forest, as well as the potential avoided loss in case of reduced deforestation. It also looks at the quantity of carbon in the stock and the associate value.

These can be assessed using the Excel worksheet provided in Annex VII.

Note that, for the carbon stored, FAO data are used. These build on the standing biomass (i.e. the trees and other vegetation above ground), but does not include the carbon in the roots, soil and litter (so called 'dead carbon'). The amount of dead carbon is different across countries, biomes and individual forests, but overall half of the carbon in forests is stored below ground, i.e. in the soils and roots[38]. The FAO data therefore may lead to an underestimate of the total amount of carbon, the total value of carbon and the value of avoided deforestation. Given data limitations it has not been possible to systematically include assessment of the 'dead carbon', with some exceptions where a sensitivity analysis was carried out. For future assessment, it is strongly encouraged that both types of carbon are accounted for.

[38] http://www.fao.org/docrep/article/001/x6893e01.htm

In addition, specific information on other related benefits should be included if easily available from the literature/interview with experts. For example, economic benefits can be a change in production of non-wood forest products. Similarly, an increase in amenity/recreation arising from an increase in forest area may be significant, either at regional or national level. This latter reflects the importance of proximity to towns/cities in determining the use of forest and other green space for recreation and amenity and in influencing people's willingness to pay for an increase in such space. The exception to this could be where a forest area is associated with species (particularly mammals or birds) of high conservation value. Overall however, quantitative assessment of non-wood forest products and change in recreation/amenity area may be more appropriate as a topic for a good local case example (see chapter 4 on case studies). Information on the extent to which forest might be important in reducing the incidence of natural disasters such as flooding, avalanches, soil loss or coastal erosion, should also be noted if available.

Monetary assessment

A monetary assessment of the additional potential carbon storage (equivalent to the emissions avoided by preventing deforestation) associated with the reduced deforestation levels can be obtained by multiplying the size of the area that will not be lost due to deforestation by the selected carbon value.

The focus is on carbon stock values and the value of avoiding potential losses – especially in those countries where deforestation is not currently an issue but where it will be important to protect and manage well the existing forest in order not to lose its current value. A range of carbon values, based on well recognised studies[39] have been used, as shown in table 8.5 below (see also chapter 5.5.3 on carbon values).

Table 8.5 Carbon value used in this study (€/t)

GHG	Range	2010	2020
Carbon dioxide (CO_2) or CO_2 equivalent	Low	17.2	39
	High	32	56

Source: based on data from EC (2008; DECC (2009); and Centre d'analyse stratégique (2009).

Overall, the carbon values are estimated here using a relatively simple procedure applicable to all countries and therefore, do not take into account local specificities and tailored assumptions. The figures provided should therefore be seen as a general illustration of the potential carbon value of forests, providing an order of magnitude rather than a precise estimate, and hopefully offering a useful starting point for future country-tailored analyses.

39 European Commission values (EC 2008 and DECC 2009) have been used as the lower carbon values and estimates from a French study (Centre d'analyse stratégique, 2009) as the higher values.

Other additional information (easily) available from the literature or other national sources on other possible monetary benefits (e.g. related to tourism revenues, entrance fees etc.) should also be noted.

8.2.2 Cropland degradation

<u>Definition of the parameter</u>

This section provides a methodology for assessing some of the benefits of a reversal of crop land degradation or, in other words, an improvement in crop land quality between a reference year (e.g. 2008) and a target year (e.g., 2020).

Definitions of key terms used in this section are:

- *Crop land:* Land used for cultivation of agricultural crops.
- *Area harvested:* Hectares of crop land multiplied by the number of harvests per year.
- *Crop yield:* Tons of crop yielded per hectare of area harvested.
- *Crop production:* Tons of crops harvested i.e. area harvested multiplied by crop yield.
- *Cereals:* Mainly wheat, barley, maize, rice, oats, sorghum, rye and millet.
- *Other crops:* Fruits, vegetables, fibre crops, oil crops, pulses, roots and tubers, tree nuts and other minor crops.
- *Crop land quality:* Here defined as those characteristics and properties of crop land that affect crop yield. Crop land quality is impaired by crop land degradation and potentially enhanced by improved crop land management.
- *Crop land degradation:* Inter-temporal changes in properties of crop land such as loss of top soil (from wind and/or water erosion), soil salinity, soil nutrient losses and other degraded physical or chemical properties of the soil.
- *Human induced degradation:* Degradation caused by human activities.
- *Improved crop land management:* Here defined as practices that reduce, prevent, or reverse crop land degradation and preserve or improve crop land quality with positive impacts on crop yield.

<u>Rationale for choice of parameter:</u> Land degradation has impacts on the economic value of land, domestic food production, water resources and ecological functions. The focus here is on the effect of land degradation on agricultural productivity in relation to crop cultivation. The Global Assessment of Soil Degradation (GLASOD) survey data presented in FAO (2000), for instance, indicates that land degradation is widespread in ENPI countries and especially in and around areas of human settlements.[40]

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[40] GLASOD collated expert judgement of soil scientists to produce maps of human induced soil degradation. Using uniform guidelines, data were compiled on the status of soil degradation

Methodological steps

Data needs: see data checklist in Annex VI.

Step 1. Describe the state of the environment (at reference point: e.g. 2008 and/or most recent year available)

Describe the current state of land degradation and its impacts. In particular, provide a brief overview of:

- Area and severity of land degradation, particularly in relation to arable land.
- Provide an assessment of crop yield effects of land degradation from existing studies and secondary data.

The geographical unit of these data can be the national or regional level depending on the geographic scope of the benefit assessment.

One source of (human induced) land degradation data is GLASOD, as mentioned above. These data classify the area of the national territory into five categories: land that is non-degraded and land with light, moderate, severe and very severe degradation. A disadvantage of the GLASOD data is that they date back more than 20 years. An advantage of the data is that economic assessments are simplified as the data provides land categories that reflect an aggregate of various forms of degradation[41]; it is therefore not necessary to undertake an economic assessment of each type of soil degradation (erosion, salinity, nutrient losses and other degraded chemical and physical properties of the soil). Economic assessments of land degradation using these data are, however, not free from problems and necessitate many assumptions. First, crop yield reductions for each land degradation category must be assumed. Second, the data do not allow for crop specific yield effects. Assumptions must therefore be made about how yields of various crops suffer from various levels of degradation. Simplifications may have to be made, depending on data availability, by aggregating crops into groups in which each crop is assumed to suffer similar yield effects. Third, the data do not provide an opportunity to accurately distribute cropped land areas across the land degradation categories. Crop area distribution assumptions must therefore be made.

Once the area of the national territory or crop land under cultivation is classified by level of degradation, crop yield reductions resulting from current levels of land degradation must be assumed. Plausible reductions are presented in the table

considering the type, extent, degree, rate and causes of degradation within physiographic units (Sonneveld and Dent, 2007).

41 Sonneveld and Dent (2007) note that the GLASOD data do not necessarily represent consistent classifications of land degradation across countries.

below using a 'low', 'medium' and 'high' scenario.[42] These yield reductions can be modified based on assessments from existing studies and secondary data in the country.

Table 8.6 Assumptions of crop yield reductions on degraded land

Land categories	Yield reduction (relative to not degraded land)		
	Low	Medium	High
Not degraded	0%	0%	0%
Mildly degraded	5%	5%	5%
Moderately degraded	10%	15%	20%
Severely degraded	15%	20%	25%
Very severely degraded	20%	25%	30%

Source: Assumptions by the Authors.

Summary of key data needs (see also data checklist in Annex VI):

- Land degradation data (at national aggregate level) with area of mildly, moderately, severely and very severely human-induced degraded land.
- Agricultural crop cultivation (area and yield by crop).
- Crop producer prices (and world market prices for cereals).
- Data on crop yield effects of land degradation.

Step 2. Define the baseline in time period of interest (e.g. 2020)

A business as usual (BAU) baseline to the target year (e.g. 2020) needs to be established. This baseline reflects the situation that is expected to prevail if no incremental efforts are undertaken to halt or reverse crop land degradation. The baseline consists of five dimensions:

- area and severity of degraded crop land in 2020
- area of crop cultivation in 2020
- distribution of crop cultivation on degraded land in 2020
- crop yields on degraded land in 2020
- projections of real crop prices to 2020

An accurate projection of area and severity of degraded crop land to the target year (e.g. 2020) may be difficult. A simplifying assumption is that the situation in the target year will be similar to today's situation. Projection of crop cultivation and yields may be based on recent trends and anticipated future changes. As a benefit assessment is usually an economic assessment, the appropriate prices to apply are world crop prices (adjusted for transportation costs) for tradable crops (e.g. cereals) and non-distorted domestic market prices for non-tradable crops (prices that would

42 The assumed yield reductions for 'moderately degraded' land are of similar orders of magnitude as average yield losses reported in Pimentel et al (1995) and a literature review of several regions of the world by Wiebe (2003).

prevail without price controls, subsidies and taxes etc.).[43] Projections of real crop prices may be based on international projections of agricultural commodity prices and other crop price forecasts for tradable crops (e.g. cereals), as well as domestic supply and demand forecasts for non-tradable crops.[44]

Summary of key data needs (see also data checklist in Annex VI):

- Area under crop cultivation in 2008 (for each crop).
- Producer prices in 2007 for each crop cultivated (most recent year available from FAO).
- World prices of cereals in 2007.
- Projections and assumptions about real crop prices from 2008 to 2020

Step 3. Target to be used

Specifying clear targets to be reached by a certain target year is an essential part of a benefit assessment. The targets can reflect goals laid out in sector or national strategies, or be scenarios for consideration when developing strategies. An example of a target is an improvement in crop land quality that results in an increase in crop yields equivalent to half of the crop yield losses from current levels of land degradation. Targets may also be established for other dimensions of crop land degradation for which benefits may be assessed if data are available (see Assessment of Benefits section below). When deciding on a target(s), it is important that actions to reach the target are identified and that the target can realistically be achieved. This includes identifying the scope and intensity of, for instance, improved crop land management practices that reduce or halt on-farm loss of top soil from erosion, reduce soil salinity, partially or fully replenish soil nutrients, and/or improve other physical and chemical soil properties.

Step 4. Assess the environmental improvements

The environmental improvements result from the measures taken to protect and (partially) restore crop land quality. These improvements are discussed in the section below.

Step 5. Assess the benefits

Many of the benefits from reaching the target(s) for improvements in crop land quality will often have to be assessed in qualitative terms while some of them can be assessed in quantitative and monetary terms. Which benefits can be assessed in quantitative and monetary terms will depend on data availability. An overview is provided in table 8.7 below.

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[43] Non-tradable crops are crops that to a very small extent are or can be exported or imported.

[44] Changes in real crop prices are nominal crop price increases minus the nominal price increases of other goods and services in the economy.

Table 8.7 Overview of the scale of the assessment: qualitative, quantitative and monetary analysis of benefits

Benefits	*Qualitative*	*Quantitative*	*Monetary*
Health	*NO*	*NO*	*NO*
Environmental	*YES*	*NO*	*NO*
Economic	*YES*	*YES*	*YES*
Social	*YES*	*NO*	*NO*

Qualitative assessment

Improvement in crop land management resulting in improved crop land quality and reversal of crop land degradation has many direct and indirect benefits including health, environmental, economic and social. Direct benefits are those that accrue on-farm, such as increased crop yields and long-term sustainability of land use. Indirect benefits are those that accrue off-farm, such as benefits from reduced soil and agro-chemical run-offs. The benefits of improving crop land quality depend on the type and effectiveness of measures taken to improve land quality. Plausible measures include soil erosion control, nutrient replenishment, improved agricultural practices and land protection measures, and improved irrigation practices and drainage. A generic overview of these benefits is provided in table 8.8 below (e.g. see also CDE, 2009). The generic overview can be modified by the particular situation in a country.

Table 8.8 Overview of key benefits of improved crop land management

Health benefits	Soil erosion control can reduce agro-chemical run-offs which can help reduce pollution of water sources used for drinking and bathing, and thus contribute to protection of health. Improved soil nutrient management can reduce the need for chemical fertilizer applications and thus reduce nitrate pollution of surface and groundwater resources used for drinking.
Environmental benefits	Soil erosion control can reduce soil run-offs and sedimentation of rivers and lakes. Sediment: causes turbidity in the water that limits light penetration and prohibits healthy plant growth on the river bed; can cover much of a river bed with a blanket of silt that suffocates life, and; is an important carrier of phosphorus, a critical pollutant which causes eutrophication. Soil erosion control and improved soil nutrient management can reduce the need for, and run-offs of, agro-chemicals and thus reduce water pollution. Improved crop land management can prevent land becoming degraded to the extent that it is abandoned (e.g. severe erosion or salinity, physical or chemical soil degradation). Thus, in some countries, improved land quality can contribute to reduced desertification.
Economic benefits	Improved crop land management enhances agricultural crop yields through improved physical and chemical soil properties and reduced salinity and erosion. Erosion control reduces sedimentation of reservoirs and dams used for irrigation, municipal water supply, and/or hydropower, and therefore increases their useful lifetime. Reduced agro-chemical run-offs from erosion control may also reduce the cost of municipal water treatment.
Social benefits	Erosion control reduces agro-chemical run-offs and therefore improves quality of water bodies used for recreation.

Quantitative and monetary assessment

Many of the benefits discussed above are very location specific and difficult to quantify without detailed local studies. The quantitative methodology here focuses on the economic benefits of improved crop land quality in terms of increased agricultural crop productivity.

The first step in the assessment is to estimate the increase in crop productivity by the target year. Increase in crop productivity may be estimated for each individual crop, or groups of crops that share similar characteristics of yield effects from land quality improvements, depending on data availability. As the magnitude of land quality improvements and yield improvements may differ spatially across the country (depending for instance on initial level of degradation and soil characteristics), distinctions may be made for different categories and/or geographic areas of crop lands. This is illustrated in the table below. The land categories may be, for instance, hectares of crop land that are mildly, moderately and severely degraded.

Table 8.9 Yield improvements by crop and land area

	Crops (or groups of crops) j=1,....n							
Land category or geographic area, i=1,...,m	J=1	J=2						J=n
I=1								
I=m								

The increase in crop productivity (y) is a fraction (β) of the crop yield loss (r) from crop land degradation.[45] Thus for crop, j, cultivated and harvested in land category or geographic area, i, the increase in crop productivity as a per cent of baseline crop yield is:

$$y_{ij} = \beta_{ij} r_{ij} / (1 - r_{ij})$$

where the size of β depends on the magnitude of crop land quality restoration.

Once the increase in crop productivity is estimated, the second step in the assessment is to estimate the total benefits of improved crop land quality in terms of increased agricultural crop productivity. Total benefits are:

45 Crop yield loss is here measured as a percentage of the crop yield that would have prevailed in the absence of crop land degradation.

$$B = \sum_{i=1}^{i=m} \sum_{j=1}^{j=n} p_{ij} (y_{ij} Q_{ij} A_{ij})$$

where p is crop price per ton in target year, Q is baseline crop yield (tons/ha) in the target year and A is area harvested (ha) in target year. Estimation of baseline crop prices, crop yields and area harvested in the target year is discussed in the above section on establishing the business as usual (BAU) baseline.

8.2.3 Level of rangeland degradation

<u>Definition of the parameter</u>

The parameter measures the area and severity of rangeland degradation.

The following definitions apply:

- *Rangeland:* rangeland is here understood as land (such as meadows and pasture) that is, or has been, used for livestock grazing. Rangeland is thus confined here to areas that are currently, or have in the past, been used by animals for grazing, and may therefore not necessarily include all meadows and pasture land.
- *Meadow:* a field of permanent grass used for hay, but also applied to rich, waterside grazing areas.
- *Pasture*: land covered with grass or herbage and grazed by, or suitable for grazing by, livestock.
- *Rangeland degradation:* it is here defined and limited to land that has lost vegetative density and/or diversity - and thus undergone a loss in animal feed productivity - resulting from livestock overgrazing or other unsuitable land uses (e.g. unsustainable crop cultivation).
- *Livestock:* animals raised, kept, and managed for use, profit or pleasure e.g. on farms.
- *Fodder or animal feed:* bulk feed for livestock, especially hay, straw etc.

<u>Unit of measurement (indicator):</u> Rangeland areas (ha) that are experiencing loss in vegetative density and/or diversity.

<u>Rationale for choice:</u> The level of rangeland degradation has impacts on the economic value of land and on ecological functions. The focus here is on the effect of rangeland degradation on fodder productivity.

Methodological steps

The benefit assessment of improved rangeland fodder productivity is based on data on rangeland fodder yields. The proposed methodology is described here and the practical steps of application are provided in the next sub-sections.

Annual animal feed loss from degradation of rangelands can be expressed as:

$$L = \sum_{i=1}^{n}(\alpha Y - \beta y)A \qquad (1)$$

where L is animal feed loss (tons of dry matter (DM) or animal feed units (FU) per year); *Y* is original yield (tons/ha/year) prior to degradation; *y* is current yield (tons/ha/year); A is area of rangeland (ha); α is sustainable utilization rate of vegetation cover before degradation; β is current utilization rate; and i=1,….n are rangeland zones or classifications.

The benefit in any given year of improving rangeland vegetation cover is then:

$$B = \sum_{i=1}^{n}(\mu I - \beta y)A \qquad (2)$$

where B is the increase in animal feed (tons/year); I is yield on improved rangeland (tons/ha/year) as defined below; and µ is the maximum utilization rate of vegetation cover that does not cause further degradation. Yields on improved rangeland will reach (by year 2020):

$$I_n = y_n + \delta_n(Y_n - y_n) \qquad (3)$$

where δ_n is a rangeland yield improvement factor in rangeland zone, *n*. For simplicity, it may be assumed that $\delta_k = \delta_l$ for all k,l of n. Inter-temporally, it may be assumed that δ_n increases linearly from 0 in the current year to 50% in year 2020.

The monetary value of B is calculated by inserting equation 3 into equation 2, multiplied by the value of a ton of dry matter (DM) or feed unit (FU) (1 kg of DM = 0.8 FU). The value may be approximated by the domestic market price of fodder or world market price of barley (alternative feed) (1 kg of barley = 1 FU).

It should be noted that utilization rates (µ, β) may be difficult to quantitatively estimate. It is therefore proposed that a rate of 70% is used as a default value in all countries. The country teams should discuss these rates with rangeland experts in their country.

Data needs: see data checklist in Annex VI.

Step 1. Describe the state of the environment (at reference point: e.g. 2008 and/or most recent year available)

Describe the current state of rangeland degradation and its impacts. In particular, provide a brief overview of:

- Area and severity of rangeland degradation (see below step 1).
- Estimates of current and original (i.e. prior to degradation) fodder yields in various parts of the country from existing studies and secondary data (see below step 2).

Geographical coverage: National level

Step 1.1: To provide an overview of area and severity of rangeland degradation, data should be collected on categories of rangeland area that either reflect distinct geographic or climatic zones or that reflect land areas with various levels of degradation (e.g. mildly, moderately and severely degraded) depending on data availability (see table below). These areas should be confined to areas that are currently or have in the past been used by animals for grazing, and may therefore not necessarily include all meadows and pasture land.

Step 1.2: To provide an assessment of current and original (i.e.prior to degradation) fodder yields, data should be collected on rangeland productivity. These data should be in the form of vegetation yields that prevailed prior to degradation ('original' yield) and that currently prevail. Yields are commonly expressed in units of dry matter (DM) or animal feed units (FU) of such vegetation types that can be utilized by animals as feed (1 kg of DM = 0.8 FU).

Reporting:
The description should be done by completing the table below.

Table 8.10 Basic data on rangeland degradation

		Yield (tons/hectare/year)	
Rangeland categories, either by distinct geographic or climatic zones or by level of degradation	Area (hectares)	Original	Current
A			
B			
C			
D			
Etc.			
Total			

Summary of key data needs (see also data checklist in Annex VI):

- Area of meadows and pasture.
- Livestock holdings (number of cattle, sheep, goats)

- World price of barley in year 2008 (barley is assumed to be an alternative feed to rangeland fodder).
- Area of rangeland (meadows and pasture currently or recently used for animal grazing.
- Current and original (prior to degradation) fodder yields on rangeland (see Step 2).
- Domestic market price of fodder in year 2008.

Step 2. Define the baseline in time period of interest (e.g. 2020)

The baseline consists of the following dimensions:

a) Area and severity of degraded rangeland in target year (e.g. 2020);
b) Fodder yield on degraded rangeland in target year, and;
c) Projections of real domestic fodder prices or world price of barley to target year.

The baseline in relation to a) and b) assume the same situation as today in the target year. Projections of real prices of barley should be used if it is not possible to make projections of domestic fodder prices.

The following table should be completed to provide a baseline in 2020.

Table 8.11 Price projections

	Reference year (e.g., 2008)	Target year (e.g., 2020)
Real fodder prices (local currency)		
Real world price of barley (US$)		

Note: Real price in reference year (2008) is simply the observed market price. Real price in target year (2020) is $P_{08} * P_{20}/I_{20}$ where P refers to market price of fodder or world price of barley in year 2008 and 2020 and I_{20} is the general price index in year 2020 relative to year 2008. The general price index to be used for real fodder prices is a projected domestic consumer price index or projected GDP deflator. The index to be used for real barley prices is a projected international consumer price index.

Step 3. Target to be used

Improvement in rangeland fodder productivity equal to one-half (50 per cent) of the difference between original (i.e. prior to degradation) and current fodder yield in each category of rangeland in Table 9.12.

Rationale: Rangeland degradation is often a long-term process and some forms of degradation are more or less irreversible. Rangeland quality can, however, be restored to some extent through controlled grazing and improved management.

Step 4. Assess the environmental improvements

The environmental improvement is the partial restoration of rangeland vegetation cover as defined above in 'Target to be used' (see table below for scale of assessment and Table 9.12 for the procedure to quantitatively estimate the improvement).

Step 5. Assess the benefits

Most of the benefits will have to be assessed in qualitative terms, some of them in quantitative term and, if data allows, in monetary terms. An overview is provided in the following table, and the methodology for each type of assessment is explained below.

Table 8.12 Overview of the scale of the assessment: qualitative, quantitative and monetary analysis of benefits

Benefits	*Qualitative*	*Quantitative*	*Monetary*
Health	*NO*	*NO*	*NO*
Environmental	*YES*	*NO*	*NO*
Economic	*YES*	*YES*	*YES*
Social	*YES*	*NO*	*NO*

Qualitative assessment

Describe the main benefits in qualitative terms. An overview of key benefits from reduced rangeland degradation is provided in the table below. Through interviews and literature research, the table should be further developed and tailored to the country specific/local situation.

Table 8.13. Overview of key benefits

Health benefits	Not applicable
Environmental benefits	Degradation of rangeland can become so severe that it causes a loss of biodiversity and can also contribute to desertification.
Economic benefits	Improved rangeland vegetation cover provides an increase in fodder.
Social benefits	Social benefits of improved rangeland may be less tangible than the economic benefits. Nevertheless, potential social benefits should be discussed qualitatively.

Quantitative assessment

The quantitative analysis focuses on the economic benefits of improved rangeland fodder productivity. The quantitative benefit of improved fodder productivity is expressed as the increase in animal feed on a hectare (ha) of rangeland in one year. Fodder productivity benefits are 50 per cent of the difference between original and baseline fodder yields in the target year (as noted above, the baseline yields is assumed the same as current yields) multiplied by the area of rangeland. The table below should be completed to arrive at tons per year of fodder improvement (units of fodder as defined in Step 2 above).

Table 8.14 Calculating the environmental improvement

		Yield (tons/year)		
Rangeland categories, either by distinct geographic or climatic zones or by level of degradation	Area (hectares)	Original[1]	Current[2]	Improvement (tons/year)[3]
A				
B				
C				
Etc.				
Total				

1. Original tons/ha/yr*Area. 2. Current tons/ha/yr * Area. 3. 50% *(original – current).

Monetary assessment

The monetary analysis focuses on the economic benefits of reduced rangeland degradation in terms of livestock fodder productivity improvements. The economic value is the total improvement in the table above multiplied by the utilization rates (default values are $\mu=\beta=70$ per cent as previously discussed) and multiplied by projected domestic prices of fodder for the target year, or alternatively projected world prices of barley (see table 9.11 on price projections).

9 METHODOLOGY FOR ASSESSING CLIMATE CHANGE RELATED BENEFITS

This part of the analysis covers the benefits (reductions in impacts) stemming from reduced national and international levels of greenhouse gas (GHG) emissions, (i.e. mitigation) and actions to be taken predominantly within the country that directly counteract specific impacts.

The main focus of the assessment relates to the risks posed by global warming to the countries under analysis and what individual countries can do to limit these risks.

To address this issue, information is needed on, for example, the state of renewable energies and estimates of potential sources (e.g. solar power) in the country. A number of other climate change parameters fall naturally under other environmental themes (e.g. methane capture under waste, water scarcity under water, desertification under nature); information needs have already been noted above and are not repeated here.

This theme covers the following sub-themes and parameters

- Sub-theme: Climate Change Drivers
    - Parameter: Deforestation (covered under nature)
    - Parameter: Methane emission from waste (covered under waste)
- Sub-theme: Climate Change Responses
    - Parameter: Uptake of renewable energy sources
    - Parameter(s): Country specific climate change adaptation, including responses to: Sea level rise; Sea temperature rise; Desertification; Water resource availability/scarcity; Pest or disease outbreaks; Risk of forest fires; Risk of floods; Other extreme weather events; Other country or region-specific climate change impacts

An Excel worksheet is provided in Annex VII to support the calculations for the 'Uptake of renewable energy sources' parameter.

9.1 Sub-theme: CLIMATE CHANGE DRIVERS

This section is included to take into account some of the drivers of climate change, in particular deforestation and methane emissions from waste, which are both contributing to increased levels of GHGs in the atmosphere.

These parameters are covered under other themes, hence they do not need to be analysed again here. However, when assessing them under the 'Nature' and 'Waste' themes, the implications for climate change should be stressed whenever possible.

Many other drivers of climate change of course exist (e.g. open burning of waste, industry and transport GHG emissions etc.) though they may not be covered under the parameters assessed in this study. If other drivers are particularly important for the country, these can also be noted.

9.2 Sub-theme: CLIMATE CHANGE RESPONSES

This sub-theme focuses on the responses to mitigate climate change. In particular, the assessment should look at the benefits of increasing the use of renewable energy sources, as these can reduce the amount of GHGs emitted by a country through a reduction in the consumption of fossil fuels. Whilst the resulting air quality improvements are primarily local and national in scale, the reductions in climate change impacts are assumed to be global.

This sub-theme also encompasses the benefits of reducing the negative impacts of climate change by means of adaptive actions. There is an obvious overlap with the benefits assessments to be undertaken in other sub-themes - most notably water and nature - and these should be duly noted to avoid duplication.

9.2.1 Mitigation: Uptake of renewable energy sources

Definition of the parameter

The parameter measures the amount of energy produced from renewable energy sources (RES) of energy.

The following definitions apply:

- *Energy from renewable sources:* energy from renewable non-fossil sources, namely: Wind, Solar, Aerothermal (energy stored in the form of heat in the ambient air), Geothermal (energy stored in the form of heat beneath the surface of solid earth), Hydrothermal (energy stored in the form of heat in surface water) and ocean energy, Hydropower, Biomass (the biodegradable fraction of products, waste and residues from agriculture - including vegetal and animal substances - forestry and related industries including fisheries and aquaculture, as well as the biodegradable fraction of industrial and municipal waste), Landfill gas, Sewage treatment plant gas, and Biogases (EC, 2009).
- *Gross final consumption of energy*: the energy commodities delivered for energy purposes to industry, transport, households, services including public services, agriculture, forestry and fisheries. This includes the consumption of electricity and heat by the energy sector in the production and delivery of electricity and heat, including losses made during distribution and transmission (EC, 2009). Here it is calculated as: total final consumption + distribution losses + own use

Unit of measurement (indicator):

- Share of RES in gross final energy consumption (%)

Rationale for choice: Important for reducing CO_2 emissions, and hence potentially mitigating climate change and its local and global impacts

Methodological steps

An Excel worksheet is provided in Annex VII to carry out the calculations listed in this methodology.

Data needs: see data checklist in Annex VI

Step 1. Describe the state of the environment (at reference point: e.g. 2008 and/or most recent year available)

Describe the current state of the energy sector. In particular, provide a brief overview of:

- Current level of energy consumed by source (data will be provided from the EIA database, but can be substituted with national official data if available) – a table is provided in the Excel file
- Current level and trends of CO_2 emissions from the energy sector – a table is provided in the Excel file
- General insights on the current situation of RES in the country
- Potential for further uptake of RES, and the major challenges and barriers (qualitative insights + some data if available)

Geographical coverage: Preferably national level; local examples (e.g. a city) can be used to further illustrate the case, if relevant.

Summary of key data needs (see also data checklist in Annex VI):

- General/qualitative insights on the state of energy production and consumption - including RES - and the key opportunities and obstacles to the further uptake of RES
- Insights on energy and emission trends (e.g. from 1990 to date; future trends if available)
- Data on energy (CO_2 emissions, gross final consumption of energy etc.) if more reliable than EIA (see below)
- Current level of CO_2 emissions
- Gross final consumption of energy, total and by fuel
- Current population and population estimates for 2020
- Conversion efficiencies for electricity, heat and combined heat and power plant.

Note: with regard to conversion efficiencies, the spreadsheet provided with this BAM has common conversion factors for different fuel types for the ENPI regions. Users can include their own country average conversion efficiencies for their capital stock. The values included in the spreadsheet are:

Fuel type	**Coal and Peat**	**Crude Oil**	**Oil products**	**Gas**	**Nuclear**	**Hydro**	**Geothermal, Solar, etc.**	**Combustible Renewables and Waste**
Efficiency electricity [%]	*30*	*30*	*30*	*50*	*40*	*90*	*80*	*75*
Eff. electricity CHP [%]	*50*	*50*	*50*	*50*	*50*	*0*	*50*	*50*
Efficiency heat [%]	*100*	*50*	*50*	*50*	*50*	*50*	*50*	*50*
Efficiency heat chp [%]	*50*	*50*	*50*	*50*	*50*	*0*	*50*	*50*

Step 2. Define the baseline in time period of interest (e.g., 2020)

It will be important to use reliable existing forecasts for energy and RES. If these are not available, a rough estimation can be made using the Excel worksheet provided in Annex VII.

The basic assumption is that energy consumption will change proportionally with the change in population (i.e. more people, more energy consumed) and that the share of fossil fuels and RES over total final consumption will remain at the actual levels in the baseline (though some variations are applied in some ENPI country analysis). Note that a very conservative estimate has been adopted for energy use per capita – that it stays at current levels. This implies that energy efficiency gains compensate for increases in energy demand (energy demand and income grow together in practice; there is as yet no decoupling). Future country analysis could usefully explore sensitivities in this baseline, namely with rising per capita demand. This will naturally mean that a 1 per cent RES share would be larger under that scenario than the more conservative one chosen in this ENPI analysis.

Renewable energy share includes both combustible renewables (e.g. wood) and waste and the 'clean' renewables such as geothermal, solar, wind etc. It is also assumed that by the target year (e.g. 2020) the amount of combustible renewable (e.g. wood) and waste will remain the same.

Summary of key data needs (see also data checklist in Annex VI):

- Data for projected gross final consumption of energy by fuel type in 2020
- Data on expected population size in 2020

Step 3. Target to be used

- At least 20 per cent of gross final consumption of energy from RES by the target year (e.g. 2020)

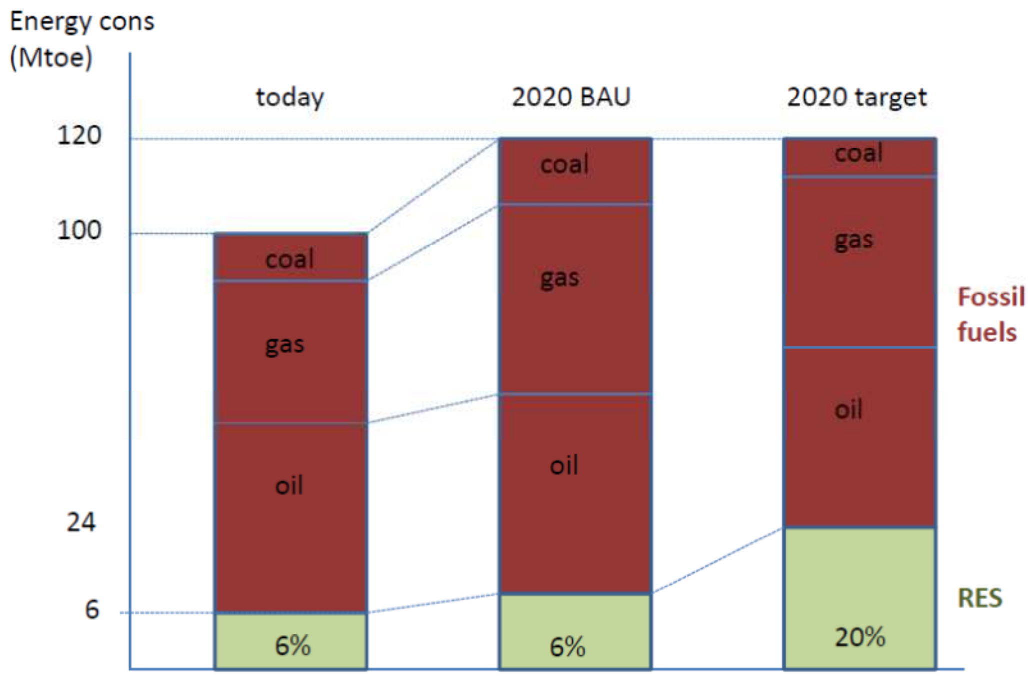
Rationale: inspired by EU Directive 2009/28/EC requiring mandatory national targets for the overall share of RES in gross final consumption of energy of 20 per cent by 2020. It is understood that this can be an ambitious target to reach by 2020 for some countries; nevertheless, it is also possible that it is already planned to carry out ambitious projects on RES in the short-medium term, especially in North Africa. The target is therefore meant to provide an estimate of the benefits to be gained from an ideal improvement – this will vary between countries. How realistic/unrealistic such a target is in each specific country should be noted by the country teams in the assessment.

Step 4. Assess the environmental improvements

The environmental improvement is based on the increase in the uptake of renewable energy if a 20 per cent target were to be reached.

This is illustrated in the figure below.

Figure 9.1. Example of environmental improvement – comparing the target with the baseline (simple numerical example)



The formulas to assess the baseline in the target year are provided in the Excel sheet and will be automatically calculated once data are inserted.

Step 5. Assess the benefits

Most of the benefits will have to be assessed in qualitative terms, some of them in quantitative term and, if data allows, in monetary terms. An overview is provided in the following table, and the methodology for each type of assessment is explained below.

Table 9.1 Overview of the scale of the assessment: qualitative, quantitative and monetary analysis of benefits

Benefits	*Qualitative*	*Quantitative*	*Monetary*
Health	*NO*	*NO*	*NO*
Environmental	*YES*	*YES*	*YES*
Economic	*YES*	*NO*	*NO*
Social	*YES*	*NO*	*NO*

Qualitative assessment

Describe the benefits in qualitative terms. An overview of key benefits from increased uptake of RES is provided in the table below. Through interviews and literature research, the following should be further developed and tailored to the country/local specific situation.

Table 9.2. Overview of key benefits

Health benefits	Reduced air emissions that can lead to pulmonary diseases. This is already covered under the 'Ambient air quality' parameter hence there is no need to cover it here.
Environmental benefits	Reduced contribution to climate change; possibility to associate RES with desalination, hence improving water availability without increasing fossil fuel consumption. It is of course crucial to make sure that possible impacts from RES to the local environment are minimised (e.g. no deforestation caused by biomass, no/limited land use change etc.)
Economic benefits	Increased energy security (thanks to increased diversification of sources and increased national production), employment opportunities in the RES sector, possible cost savings in energy production (on a case by case level – e.g. wind energy in some areas may prove cheaper than renovating/building new power plants).
Social benefits	Possibility to provide energy to isolated locations (not connected to the electricity grid).

Quantitative assessment

- **Environmental benefits**

The quantification assessment focuses on the environmental benefits related to increased substitution of fossil fuels with RES, resulting in a decrease in CO_2 emissions. The analysis should estimate the amount of CO_2 that, hypothetically, will not be emitted if the target of 20 per cent RES uptake were to be reached (with variants in targets used in the country specific analysis, given that the ENPI countries have different RES 'starting points').

The formulae are provided in the Excel sheet and will be automatically calculated once data are inserted.

It is assumed here that the environmental improvement results from the reduction in climate change impacts (and ancillary air quality improvements). Whilst the resulting air quality improvements will be primarily local and national in scale, the reductions in climate change impacts are assumed to be global.

Monetary assessment

To assess the monetary value of an increased uptake of renewables, well recognised EU studies have been looked at to choose the most suitable value for carbon price in 2020 (see also chapter 5.5.3 on carbon values). Two values for CO_2 (upper and lower) for 2020 have been used in the ENPI study: €39 and €56/tCO_2. The range of values is shown in the table below.

Table 9.3 Carbon value used in this study (€/t)

GHG	Range	2010	2020
Carbon dioxide (CO_2) or CO_2 equivalent	Low	17.2	39
	High	32	56

Source: based on data from EC (2008; DECC (2009); and Centre d'analyse stratégique (2009)

The calculation is provided in the Excel worksheet. The rationale is as follows:

Emission savings * carbon price (high/low) = total monetary benefits from reduced emissions due to increased uptake of RES.

It should be noted that carbon values are assumed to be the same in all countries, as climate change is a global issue, and also assuming potential tradability of CO_2.

9.2.2 Country specific climate change adaptation

<u>Definition of the parameter(s)</u>

There are a number of parameters in this sub-theme, relating to the different potential impact types. Some are addressed under other themes in the Benefits Assessment (e.g. water scarcity). Key parameters, and suggested metrics for possible quantification, include:

- Sea level rise: measuring projected sea level rise (cm) and associated damage to people, property and other assets (natural & man-made) resulting from sea level rise
- Sea temperature rise: measuring damage to marine life resulting from sea temperature rise (species change etc.)
- Desertification: measuring damage to assets (natural & human-made) resulting from desertification (hectares of land affected)
- Water resource availability/scarcity: measuring change in water resource availability due to changes in rainfall and evapo-transpiration (Ml/day) (some overlaps with water resource use parameter)

- Pest or disease outbreaks: measuring change in risk of pest (lost agricultural productivity) or change in disease outbreaks and heat-related morbidity & productivity (number of people affected etc.)
- Risk of forest fires: measuring change in risk of forest fire (hectares of land affected and frequency of event) (some overlaps with deforestation parameter)
- Risk of floods: measuring change in risk of urban and riverine floods resulting in damage to property and other assets (hectares of land affected, and frequency of event; number of people affected etc.)
- Other extreme weather events: change in frequency of other extreme weather events, including windstorms (damage to assets (natural & man-made); frequency of event; number of people affected)
- Other country or region-specific climate change impacts

Rationale for choice: The parameter measures suggested above are selected with a view to describing the changes in the parameters brought about by climate change in the most easily understood way. However, this list of measures can be supplemented by other measures that are currently used in country- or region-specific analysis of the impacts of climate variability and climate change.

Methodological steps

Data needs: see data checklist in Annex VI.

Step 1. Describe the state of the environment (at reference point: e.g. 2008 and/or most recent year available)

For the sake of completeness, all the key impacts from climate change should be listed, while a more detailed analysis should be carried out for 2-3 key impacts that are most relevant for the country and for which adaptation benefits can actually be quantified to some level.

The degree to which the country is currently vulnerable to climate variability and how it may be vulnerable to projected climate change should be described.
In particular, a brief overview should be provided for:

- The current climate (e.g. seasonal average temperatures and rainfall patterns in different parts of the country; recent extreme weather events).
- The number of people employed in climate-sensitive industries (e.g. agriculture, water supply, fisheries).
- Examples of the impacts of recent extreme weather events (e.g. number of people affected and costs of damage to property due to recent droughts, heat waves, floods, and the current frequency of such events, if possible).
- Existing trends in desertification, coastal erosion, agricultural and fish yields and other effects that may be climate-determined.

- Description of the current vulnerability of human populations and the natural environment to projected climate change and variability, and their capacity to respond.
- Identification of options/actions to respond to climate risks and information on their costs and benefits (if information available).
- Specific insights on the parameters selected.

Geographical coverage: Preferably national level, or regional level if data are not available; local examples (e.g. a city) can be used to further illustrate the case, if relevant.

The value of the exercise will depend on the ability to identify: a) climate risks; and b) possible adaptation options. It may also be possible that climate impacts are assessed on a regional, rather than national, basis. In this case, information should be tailored to national circumstances.

Summary of key data needs (see also data checklist in Annex VI):

- General/qualitative and quantitative insights of impacts associated with climate variability and projected climate change, key issues including sectoral and household sensitivity to current and projected future climate – some of the data needed for some of the parameters analysis are likely to be shared with other sub-themes. The data should attempt to respond to the individual bullet points (7) listed above (at least those that are relevant in the country and for which data are easily available).
- Insights on adaptation measures that respond to the identified climate risks (current/planned/potential)
- Agricultural production (type, volume, value)
- GDP/capita
- Population projections
- GDP projections
- Energy supply
- Data available internationally that can help to supplement the country- or region-specific data collected by the country teams.

Step 2. Define the baseline in time period of interest (e.g. 2020)

Estimate how many people will be exposed to climate risks in 2020, according to estimates provided in the literature or by experts. If the literature refers to several scenarios, please include them.

Alternative approach (not used in this project, but could be feasible for future BA studies): gather information on the projected impacts of climate change in 2020 - including population exposure, but also other impacts on the environment, the economy and society - according to existing assessments (often found in national adaptation strategies or other external assessments like UNDP reports etc.).

Step 3. Target to be used

For this study the selected target was to limit global warming to 2° Celsius (3.6° Fahrenheit) above pre-industrial levels in 2050 – i.e. in the short term, shifting GHG emissions to a pathway consistent with the 2° C target.

Climate change effects and targets are usually based on a longer timescale than that considered in this assessment (2020). The existing literature is likely to make reference to medium - long term climate change measures and impacts in the country. Therefore, although our analysis focused on the 2020 horizon (for consistency with the other parameters), longer term effects of climate change were also taken into account – for example the impacts expected in 2050 if no action is taken, the effect of possible counter measures to achieve the 2° target etc. – as these are likely to be the focus of the available research/studies.

Rationale for target chosen: According to the International Panel on Climate Change (IPCC, 2007) significant global impacts on ecosystems and water resources are likely at global temperature increases of between 1 and 2° C, and the risks of net negative impacts on global food production occur at temperature increases upwards from 2-2.5° C compared to pre-industrial levels. In 1996 the European Union[46] settled upon 2° Celsius as a yardstick for measuring success in fighting climate change, arguing that anything more would be 'dangerous' for life on the planet. Note that even a 2° Celsius increase (expected to relate to 450ppm of carbon dioxide in the atmosphere) will lead to important irreversible damages, notably to coral reefs (upon which 500 million people depend worldwide for a range of services). It is understood that around 350 ppm would be more appropriate to avoid coral damage and allow coral reef recovery (TEEB 2011, page 17).

Alterative approach (not used in this project, but could be feasible for future BA studies): should information on a 2° C scenario not be available, the analysis could focus on the benefits of minimising the impacts of climate change described in the baseline scenario by adopting adaptation measures which are recommended for the specific country in existing studies.

Step 4. Assess the environmental improvements

The environmental improvement is based on the extent to which the population is able to reduce vulnerability to climate change as a result of adapting to climate change over a range of the most significant current and projected impacts.

Should the improvements be hard to assess, they should be described at least in qualitative terms.

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[46] The EU's global temperature target of 2° C above pre-industrial was first established in 1996 during preparations for the Kyoto negotiations, and has been reaffirmed subsequently in various Environment Council and European Council conclusions. This limit was deduced in 1996 from the evidence available at the time, mostly from impacts studies that were assessed in the Second Assessment Report of the Intergovernmental Panel on Climate Change (IPCC SAR, 1996a,b,c).

Step 5. Assess the benefits

Most of the benefits are to be assessed in qualitative terms, some of them in quantitative terms and, if data allows, in monetary terms. An overview is provided in the following table, and the methodology for each type of assessment is explained below.

Table 9.4. Overview of the scale of the assessment: qualitative, quantitative and monetary analysis of benefits

Benefits	***Qualitative***	***Quantitative***	***Monetary***
Health	*YES*	*if data allows*	*if data allows*
Environmental	*YES*	*if data allows*	*if data allows*
Economic	*YES*	*if data allows*	*if data allows*
Social	*YES*	*if data allows*	*if data allows*

Qualitative assessment

Describe the benefits of adapting to climate change in qualitative terms. An overview of a number of possible benefits from reducing vulnerability to climate is provided in the table below. Through interviews and literature research, the following should be further developed and tailored to the country/local specific situation.

Table 9.5. Overview of key benefits

Health benefits	Health benefits will accrue particularly in the communities which are currently most vulnerable to climate-related illnesses and disease. These include vector-borne disease, water-borne disease and those related to temperature e.g. cardio-vascular and respiratory illnesses. These may be fatal or non-fatal and affect children and the elderly disproportionately.
Environmental benefits	Climate change adaptation through conservation efforts will ensure that species, habitats and ecosystems are maintained. Flood and coastal management practices introduced in response to climate change will also help protect vulnerable habitats such as salt marshes.
Economic benefits	Adaptation through flood management and generic design specification will limit economic assets such as property and the wider infrastructure (e.g. transport, water distribution and energy transmission networks) from being damaged or disrupted and so limit wider economic disruption. Investment in adaptation measures may also provide an economic stimulus to a region or country.
Social benefits	The process of identifying and implementing adaptation at a community or wider level may serve to generate greater social cohesion, and adaptive capacity per se. Vulnerability to climate change is most often at its greatest in socially disadvantaged groups. For example, poorer households may live on a flood plain that is susceptible to riverine floods, and so face relatively high risks of flood inundation and property damage.

Quantitative assessment

If data from existing literature or from experts is available, some of the benefits from tackling climate change should be quantified. The assessment should focus on the estimation of the additional number of people who are protected from the range of climate risks identified above. The overlap with other environmental themes (e.g. water, nature) should be taken into account.

Monetary assessment

In the case of certain specific climate change risks (e.g. changes in property damage resulting from increased frequency of flood events) it may be possible to both quantify the damages prevented by adaptation measures and to express these damages in monetary terms. If some of the benefits have been monetised in the existing literature or by reliable experts, their key findings should be noted. Findings from other countries could also be adopted/transferred to the country under analysis by way of illustration.

As a result of a general lack of quantitative data on climate parameters, and their translation in terms of, as an example changes in frequency of extreme weather events, it is possible that the monetisation assessment may be too difficult or impractical. In this study for instance, no specific calculations were suggested for the monetary assessment and information was provided only if readily available from existing sources. It is therefore particularly important that the qualitative assessment is exhaustive and accurate in order to communicate the key messages on the benefits of adaptation.

10 CONCLUSIONS AND THE WAY FORWARD

It is important that a benefit assessment conveys effectively the key messages regarding the benefits brought by environmental improvements. Once the analysis is completed, it will therefore be important to draw summary conclusions on the key environment issues that needs particular attention; the most important benefits from environmental improvements; and data gaps and methodological assumptions and limitations (to ensure transparency and manage expectations).

It will also be useful to formulate recommendations on how to improve data availability and ways to overcome data gaps, as well as on how to use the outcome of the benefit assessment. More advanced assessment could also suggest possible measures to achieve the benefits, and/or better targets, to ensure the environmental improvements are effectively achieved.

Sensitivity analysis using different assumptions – for example, in terms of timeline and ambition of the targets, different future population and GDP projections, range of unit values for CO_2, VSL, WTP and so on – could be carried out in order to achieve a better understanding of how the benefits can change under different circumstances.

As noted before, the coverage of this manual in terms of themes, parameters and assumptions was limited by the scope and resources of this project. However, this should not be seen as a limitation for new benefits assessments. Instead, future users should be free to tailor this Manual to their own country/local needs and priorities. Notably, additional parameters can and should be explored in future benefit assessments, such as nuclear waste, energy efficiency, chemical substances, desertification and other important environmental topics relevant to the area under study.

It is also important to note that some environmental issues, such as nature protection and forest management, can have a very local dimension and may deserve to be explored through local case studies rather than nationwide assessments. Other issues, such as air pollution and water quality and availability, may have relevant cross-country implications; in such cases, transnational benefits should be taken into account whenever possible.

The users should also seek additional data that may become available in the future and could help improve the methodology for the assessment, for instance, if national environmental accounts are developed, or relevant international studies completed (e.g. future studies in the context of the Economic of Ecosystems and Biodiversity (TEEB), upcoming updates of the World Bank's Cost of Environmental Degradation, new databases by the Food and Agriculture Organization etc.).

This Manual should therefore be seen as a flexible framework that can be tailored to different geographic and temporal frameworks, data availability and methodological tools. The authors hope it can encourage the wider development and use of benefits assessments and help to highlight the benefits of protecting the natural environment through sound environmental policy and the integration of environmental perspectives into broader national and local policies.

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ANNEX I – USEFUL REFERENCES FOR DATA GATHERING

- ***Previous benefit studies***

A number of 'benefit studies' have been conducted in the past decade for the European Commission, assessing the benefits for former acceding countries of adopting the EU Acquis and hence improving their environmental legislation.

Year	Title/project/initiative	Country	Topic/relevance
2001	ECOTEC, EFTEC, IEEP, Metroeconomica, TME and Candidate Country. (2001) *The Benefits of Compliance with the Environmental Acquis for the Candidate Countries*	12 acceding countries + Turkey	The results illustrate very significant benefits, including in terms of improved human health and longevity, as well as other social and economic benefits. They demonstrate how investment of human and financial resources in improving environmental policy provides a real return in terms of increased societal well-being.
2005	Ecolas and IEEP (2005) *The benefits for Croatia of Compliance with the Environmental Acquis*	Croatia	
2007	Arcadis-Ecolas, IEEP, Metroeconomica, Enviro-L (2007) *Benefits for fYRoM and other countries of SEE of compliance with the environmental acquis*	Albania, Bosnia, Montenegro FYROM, Serbia	
2008	ten Brink, P. and S. Bassi (2008) *Benefits of Environmental Improvements in the European Neighbourhood Policy (ENP) Countries – A Methodology.* A project working document for DGENV.	Broader methodology for ENP + scoping study on Ukraine	Adaptation of benefit study methodology to ENP countries. Scoping study on Ukraine but not a full benefit study.

- ***Biodiversity valuation studies***

Year	Title/project/initiative	Country	Topic/relevance
2010	G8+5, BMU (DE) and the European Commission, supported by Defra (UK), UNEP, OECD, CBD Secretariat, VROM, EEA, UFZ, IUCN, University of Liverpool, IEEP et al (2008,2009a, 2009b, 20010, 2011 and 2011 forthcoming and 2012forthcoming) The Economics of Ecosystems and Biodiversity (TEEB)	world	A series of reports focusing on improving the understanding of the economic costs of biodiversity loss and ecosystem degradation and to communicate this understanding to key stakeholders http://www.teebweb.org/ and four books – one published in 2010 (TEEB 2010), another in 2011 (TEEB 2011) and the other two expected either at the end of 2011 or earlier 2012.
ongoing	Gantioler S., A. McConville A, K.	EU	A study on the cost and benefits of Natura 2000

(2010)	McCoy K, P. ten Brink, S. Bassi, (IEEP), M. Rayment M (GHK) and I. Braeuer (Ecologic) (2010-ongoing) Preparatory Actions For Natura 2000 Lot 1: The Economic and Social Benefits associated with the Natura 2000 Network		sites.
	Kettunen, M., Bassi, S., Gantioler, S. & ten Brink, P. 2009. Assessing Socio-economic Benefits of Natura 2000 – a Toolkit for Practitioners (September 2009 Edition). Output of the European Commission project Financing Natura 2000: Cost estimate and benefits of Natura 2000 (Contract No.: 070307/2007/484403/MAR/B2). Institute for European Environmental Policy (IEEP), Brussels, Belgium. 191 pp. + Annexes.	EU	A methodology for assessing the value of ecosystem services within EU Natura 2000 sites. It includes a range of values and examples of ecosystem services values, some of which can be of relevance for the ENPI countries.
2008	*Bakkes J.A. (MNP), Bräuer I. (Ecologic), ten Brink P. (IEEP), Görlach B. (Ecologic), Kuik O.J. (IvM),Medhurst J. (GHK), 2006*: Cost of Policy Inaction – the case of not meeting the 2010 biodiversity target - Scoping study for DG Environment	world	The study illustrates that in the absence of additional biodiversity protection, a failure to halt biodiversity loss could come at a considerable price sometime in the future, because natural systems will be no longer able to supply valuable services such as carbon storage in forests and the supply of sufficient clean fresh water. An updated version of the COPI study, including a broader database of information and a closer look at the issue of substitutability of ecosystem services, has been released in 2009.
2009	ten Brink, P., Rayment, M., Bräuer, I., Braat, L., Bassi, S., Chiabai, A., Markandya, A., Nunes, P., ten Brink, B., van Oorschot, M., Gerdes H., Stupak, N., Foo, V., J. Armstrong, Kettunen, M., & Gantioler, S. 2009. Further Developing Assumptions on Monetary Valuation of Biodiversity Cost Of Policy Inaction (COPI). European Commission project – final report. Institute for European Environmental Policy (IEEP), London / Brussels, 83 pp. + Annexes.	world	An update of the above study, with a broader database and further insights on the substitutability of ecosystem services with natural and artificial alternatives.
2006	*Kettunen, M. & ten Brink, P. 2006.* Value of biodiversity - Documenting EU examples where biodiversity loss has led to the loss of ecosystem services. Final report for the European Commission. Institute for	EU	Examples of the assessment of the loss of biodiversity and ecosystem services value in a range of case studies across the EU.

	European Environmental Policy (IEEP), Brussels, Belgium. 131 pp.		
2002	*ten Brink P, C Monkhouse and S Richartz* Promoting the Socio-Economic Benefits of Natura 2000.Background Report for European Conference on 'Promoting the Socio-economic Benefits of Natura, Brussels 28-29 November 2002, IEEP	EU	A study assessing the socio economic benefits of EU Natura 2000.
2011	White, S., I. Liekens, K. Ninan, P. Meire, C. Shine, B. Simmons, R. Tinch, J. Wielgus and P. ten Brink (2011) *Recognising the value of biodiversity: new approaches to policy assessment*.	world	In *The Economics of Ecosystems and Biodiversity (TEEB) in National and International Policy Making* An output of TEEB, edited by Patrick ten Brink, IEEP. Earthscan, London.

- ***Valuation studies and related information***

Year	Title/project/initiative	Country	Topic/relevance
2000	Background paper on Valuing Environmental Benefits and Damages in the NIS: Opportunities to integrate environmental concerns into policy and investments decisions, Almaty, 16-17 October 2000, OCDE.	Armenia Azerbaijan Belarus Georgia Kazakhstan Kyrgyzstan Moldova Russian Federation Ukraine Uzbekistan	Environmental benefits and damages.
2008	IBRD/World Bank - Global Purchasing Power Parities and Real Expenditure, 2005 International Comparison Program (ICP)	world	Information on gross domestic product (GDP), GDP per capita, household consumption, collective government consumption and capital formation. The principal outputs are estimates of Purchasing Power Parities (PPPs) benchmarked to the year 2005.

- ***Broad environmental, economic and social data/analysis***

Year	**Source**	**Country**	Topic/relevance
various	The Institute for Environment and Sustainability (IES) http://ies.jrc.ec.europa.eu/index.php?page=data-portals	EU + world	The IES manages a large number of unique pan-European and global databases. Environmental and social data.
various	World Resources Institute databases http://www.wri.org/	More than 200 countries	Free online database that focuses on the environmental, social, and economic trends.
various	United Nations Statistics http://unstats.un.org/unsd/default.htm	world	Several databases on economics, demographics, environment etc.
various	UNEP GEODATA portal http://geodata.grid.unep.ch/	various	It holds more than 500 different variables as national, sub-regional, regional and global statistics or as geospatial data sets (maps), covering themes like Freshwater, Population, Forests, Emissions, Climate, Disasters, Health and GDP

various	The World Data Center for Human Interactions in the Environment http://sedac.ciesin.columbia.edu/wdc/	various	Geophysical and environmental data free of charge or for the cost of reproduction. Data sets related to population, sustainability, poverty, health, hazards, conservation, governance and climate.
various	European Commission - ENP country reports http://ec.europa.eu/world/enp/documents_en.htm	ENP countries	Economic and social overview, including some info on environmental state.
Time series up to 2008	World Bank - World Development Indicators Online (WDI) http://web.worldbank.org/WBSITE/EXTERNAL/DATASTATISTICS/0,,contentMDK:20398986~menuPK:64133163~pagePK:64133150~piPK:64133175~theSitePK:239419,00.html	world	800 development economic and social indicators. Environmental data including land use and agricultural production, energy production and use and emissions
various	FAOSTAT www.fao.org	200 countries	Time-series and cross sectional data relating to food and agriculture. Country profiles including info on land, water, soil erosion, soil salinity, forest, rangeland etc (info varies by country). Statistics on area of rangeland, irrigated land, agricultural land, cropping patterns, crop yields etc GDP, forest land, agricultural land, water and sanitation, child mortality, population growth, urban population growth, population age distribution, crude birth rate (some other indicators of relevance are also available but it is better to take them from DHS and MICS and www.childinfo.org (malnutrition).)
various	World Bank - World Development indicators http://ddp-ext.worldbank.org/ext/DDPQQ/member.do?method=getMembers&userid=1&queryId=135 HNP statistics http://ddp-ext.worldbank.org/ext/DDPQQ/member.do?method=getMembers&userid=1&queryId=225	world	
2007	UNDP -'Rapport National sur le Développement Humain	Algeria	Provides a calculation of the Human development Index (HDI) at regional level
2009	the Interstate Statistical Committee of the CIS (CIS-STAT) and Eurostat -The EU and the CIS	CIS countries: 11 countries including the 7 ENPI eastern countries	Statistical comparison in the last 10-year period of: population, employment, economy, agriculture and forestry, energy, industry and international trade in goods and services

- ***Focus: Economics and demography***

Year	Source	Country	Topic/relevance
2009	Eurostat - European Neighbourhood Policy - overview of recent economic developments - a comparison with the EU 2009 http://ec.europa.eu/world/enp/publications_en.htm	ENP countries	Economic data
2007	ECFIN - Occasional Papers No 30: European Neighbourhood Policy: Economic Review of ENP Countries	ENP countries	Economic review
2008	IBRD/World Bank - Global Purchasing Power Parities and Real Expenditure, 2005 International Comparison Program (ICP) http://siteresources.worldbank.org/ICPINT/Resources/icp-final.pdf	world (146 countries)	Information on gross domestic product (GDP), GDP per capita, household consumption, collective government consumption, and capital formation. The principal outputs are estimates of Purchasing Power Parities (PPPs) benchmarked to the year 2005.

- ***Focus: Health data/report***

Year	Source	Country	Topic/relevance
yearly	UNICEF The State of the World's Children	world	Data on child mortality/health
(1990-2006)	UNICEF Drinking water and sanitation coverage: country and regional estimates by type of drinking water and sanitation facilities	world	Drinking water and sanitation
	UNICEF WHO / UNICEF Joint Monitoring Programme for Water Supply and Sanitation	world	Country profiles - Water Supply and Sanitation
	WHO Environmental Pollution Website	world	
	Environmental burden of disease: Country profiles	world	Information on selected parameters that describe the environmental health status of a country, as well as a preliminary estimate of health impacts caused by environmental risks.
	the MEASURE DHS (Demographic and Health Surveys) project	world	National data on fertility, family planning, maternal and child health, gender, HIV/AIDS, malaria, nutrition, wealth and socioeconomics.
2009	WHO Environmental burden of disease: Country profiles http://www.who.int/quantifying_ehimpacts/countryprofiles/en/	world	Mortality estimate from urban air, indoor air, water-sanitation-hygiene (country profiles of environmental burden of disease).
	UNICEF Childinfo statistics www.childinfo.org	world	Water sanitation statistics; child mortality/malnutrition. Multiple Indicator Cluster Survey (MICS 3): type of water supply, sanitation, household water treatment;

			households fuels, diarrheal and respiratory infections in children under five; child malnutrition; population age distribution etc.
	MACRO Demographic and Health Surveys (DHS): www.measuredhs.com	world	National data on fertility, family planning, maternal and child health, gender, HIV/AIDS, malaria, nutrition, wealth and socioeconomics. Water, sanitation, household water treatment, diarrheal and respiratory infections in children under five; household use of solid fuels; child mortality; child malnutrition; population age distribution

- ***Focus: environment***

Year	Source	Country	Topic/relevance
various	IUCN, the International Union for Conservation of Nature http://www.iucn.org/knowledge/	various	Publications on nature/biodiversity issues – worth looking in the publication page for ENP related publications.
various	UNEP World Database on Protected Areas http://www.wdpa.org/	various	A dataset for conservation decision making. It contains information from national governments, non-governmental organizations, academic institutions, international biodiversity convention secretariats and many others.
various	IEEP - European Nature Information System (EUNIS) http://eunis.eea.europa.eu/index.jsp	EU + ENPI East	Data on species, habitats and sites
2008	P. ten Brink and S. Bassi (2008) *Benefits of Environmental Improvements in the European Neighbourhood Policy (ENP) Countries – A Methodology.* A project working document for DGENV.	Broader methodology for ENP + scoping study on Ukraine	Adaptation of benefit study methodology to ENP countries. Scoping study on Ukraine but not a full benefit study.
2008	*Bakkes J.A. (MNP), Bräuer I. (Ecologic), ten Brink P. (IEEP), Görlach B. (Ecologic), Kuik O.J. (IvM), Medhurst J. (GHK), 2006*: Cost of Policy Inaction – the case of not meeting the 2010 biodiversity target - Scoping study for DG Environment	world	The study illustrates that in the absence of additional biodiversity protection, a failure to halt biodiversity loss could come at a considerable price sometime in the future, because natural systems will be no longer able to supply valuable services such as carbon storage in forests and the supply of sufficient clean fresh water. An updated version of the COPI study, including a broader database of information, and a closer look at the issue of substitutability of ecosystem services, has been released in 2009. Covers worldwide examples including some ENPI countries.
2010	G8+5, BMU (DE) and the European Commission, supported by DEFRA (UK), UNEP, OECD, CBD Secretariat, VROM, EEA, UFZ, IUCN, University of Liverpool, IEEP et al (2010) The Economics of Ecosystems and Biodiversity	world	A series of reports focusing on improving the understanding of the economic costs of biodiversity loss and ecosystem degradation and to communicate this understanding to key stakeholders http://www.teebweb.org/

	(TEEB)		
various	UNEP's Global Resource Information Database (GRID), http://www.grid.unep.ch/	world	Environmental data, state of the world's environment and emerging environmental threats.
various	The United Nations Global Environment Monitoring System (GEMS) Water Programme http://www.gemswater.org/	various	Environmental water quality data and information. GEMStat is designed to share surface and ground water quality data sets collected from the GEMS/Water Global Network, including more than 3,000 stations, close to four million records, and over 100 parameters.
2010	UNEP The State of the Environment and Development in the Mediterranean 2009 http://www.planbleu.org/actualite/uk/soed2009_Uk.html	Mediterranean countries	The report provides a picture of the major issues in the Mediterranean in terms of environment and sustainable development (including marine pollution, conservation of biodiversity and natural resources like water and energy, climate change etc.)
various	International Energy Agency databases	world	Detailed international data on coal, electricity, natural gas, oil, renewables, carbon dioxide emissions from fuel combustion, energy prices and taxes, energy technology research and development, world energy statistics and balances, and forecasts from energy policies.
2009/2010	UNDP _Climate Change in Moldova: Socio-Economic Impact and Policy Options for Adaptation	Moldova	Analysis of the significant impact of climate variability and climate change and extreme weather events on sectors vital to human development in Moldova: water resources, ecosystems, agriculture and energy, transport infrastructure and health.
	University of the Aegean Eutrophication in Med countries: http://www.iasonnet.gr/abstracts/karydis.html	Mediterranean countries	Eutrophication - map
2008	UNEP, MAP, WHO - Mediterranean Action Plan http://195.97.36.231/acrobatfiles/MTSAcrobatfiles/mts170.pdf	Mediterranean countries	Assessment of the state of microbial pollution in the Mediterranean Sea – including eutrophication
	IUCM, IWMI, Ramsar, WRI Environmental Water Scarcity Index by Basin http://prelive.earthtrends.org/pdf_library/maps/watersheds/gm16.pdf	world	Water availability
	UNESCO, WMO, IAEA http://www.unesco.org/water/wwap/wwdr/wwdr2/pdf/wwdr2_ch_4.pdf	world	Good overview of water availability and resources
Various	The Environment Performance Index (Yale University) www.epi.yale.edu	world	The EPI was developed to benchmark the environmental performance of a country relative to other countries. The index has two major environmental objectives: (a) reducing environmental stresses on human health; and (b) promoting ecosystem vitality and sound natural resource management.

- ***Cost of degradation reports***

In the period 2000 to 2005, the World Bank's Mediterranean Environmental Technical Assistance Programme (METAP) conducted country studies of the cost of environmental degradation in 7 countries in the Mediterranean: Algeria, Egypt, Jordan, Lebanon, Morocco, Syria, and Tunisia. The project consisted of country studies and a training course. From 2006 to 2010, the METAP, which will be replaced by Sustainable Med by June 2010, has produced the Cost of Coastal Zone Environmental Degradation (CCZED) for the Mediterranean countries: Algeria, Egypt, Lebanon, Morocco, Syria and Tunisia. The aim was to foster integration of environmental issues into broader economic development. Moreover, 3 COEDs were updated through World Bank Economic and Sector Work and the METAP: Jordan (2009), Lebanon (2011) and Syria (2010).

Costs were estimated for 6 categories: Air pollution; Lack of access to water supply and sanitation services; Land degradation; Coastal zone degradation; Waste management; and Global environment.

Year	Source	Country	Reference
2004	Cost of Environmental Degradation– Report	Algeria	http://siteresources.worldbank.org/EXTMETAP/Resources/COED-AlgeriaCR-FR.pdf
2004	Cost of Environmental Degradation – Profile	Algeria	http://siteresources.worldbank.org/EXTMETAP/Resources/COED-AlgeriaCP.pdf
2004	Seawater and Brackish Water Desalination	Algeria	http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2005/09/08/000160016_20050908163547/Rendered/PDF/335150v20Seawater0Annex10Algeria.pdf
2002	National Environmental Action Plan	Algeria	http://www-wds.worldbank.org/external/default/main?menuPK=64187510&pagePK=64193027&piPK=64187937&theSitePK=523679&menuPK=64154159&searchMenuPK=64258544&theSitePK=523679&entityID=000094946_02091104072760&searchMenuPK=64258544&theSitePK=523679
2007	Cost of Coastal Zone Environmental Degradation	Algeria	http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/MENAEXT/EXTMEDSTRPART/0,,contentMDK:22500563~pagePK:64168445~piPK:64168309~theSitePK:5147588,00.html
2004	Cost of Environmental Degradation – Report	Egypt	http://siteresources.worldbank.org/EXTMETAP/Resources/COED-EgyptCR.pdf
2004	Cost of Environmental Degradation – Profile	Egypt	http://siteresources.worldbank.org/EXTMETAP/Resources/COED-EgyptCP.pdf
2007	Cost of Coastal Zone Environmental Degradation	Egypt	http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/MENAEXT/EXTMEDSTRPART/0,,contentMDK:22500563~pagePK:64168445~piPK:64168309~theSitePK:5147588,00.html
2004	Cost of Environmental Degradation – Profile	Jordan	http://siteresources.worldbank.org/EXTMETAP/Resources/COED-JordanCP.pdf
2004	Seawater and Brackish Water Desalination	Jordan	http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2005/09/08/000160016_20050908164250

			/Rendered/PDF/335150v40Seawater0Annex30jordan.pdf
2009	Country Environmental Analysis	Jordan	http://www-wds.worldbank.org/external/default/main?pagePK=64193027&piPK=64187937&theSitePK=523679&menuPK=64187510&searchMenuPK=64187283&theSitePK=523679&entityID=000333037_20100907235120&searchMenuPK=64187283&theSitePK=523679
2004	Cost of Environmental Degradation Lebanon and Tunisia-Report	Lebanon	http://siteresources.worldbank.org/INTMNAREGTOPENVIRONMENT/Resources/COEDCountryReportLebanon_Tunisia_Eng_French.pdf
2004	Cost of Environmental Degradation – Profile	Lebanon	http://siteresources.worldbank.org/EXTMETAP/Resources/COED-LebanonCP.pdf
	COED presentation	Lebanon	http://siteresources.worldbank.org/EXTMETAP/Resources/COEDCR-Lebanon.pdf
2009	Cost of Coastal Zone Environmental Degradation	Lebanon	http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/MENAEXT/EXTMEDSTRPART/0,,contentMDK:22500563~pagePK:64168445~piPK:64168309~theSitePK:5147588,00.html
2011	Country Environmental Analysis	Lebanon	http://www-wds.worldbank.org/external/default/main?pagePK=64193027&piPK=64187937&theSitePK=523679&menuPK=64187510&searchMenuPK=64187283&theSitePK=523679&entityID=000356161_20110608023457&searchMenuPK=64187283&theSitePK=523679
2004	Cost of Environmental Degradation – Report	Morocco	http://siteresources.worldbank.org/EXTMETAP/Resources/COED-MoroccoCR-fre.pdf
2004	Cost of Environmental Degradation – Profile	Morocco	http://siteresources.worldbank.org/EXTMETAP/Resources/COED-MoroccoCP.pdf
2004	Cost of Environmental Degradation –Summary	Morocco	http://siteresources.worldbank.org/INTMNAREGTOPENVIRONMENT/Resources/Final_French_Morocco.pdf
2007	Cost of Coastal Zone Environmental Degradation	Morocco	http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/MENAEXT/EXTMEDSTRPART/0,,contentMDK:22500563~pagePK:64168445~piPK:64168309~theSitePK:5147588,00.html
2004	Cost of Environmental Degradation – Report	Syria	http://siteresources.worldbank.org/EXTMETAP/Resources/COEDCP-Syria.doc
2004	Cost of Environmental Degradation – Profile	Syria	http://siteresources.worldbank.org/EXTMETAP/Resources/COED-SyriaCP.pdf
2010	Cost of Environmental Degradation	Syria	http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/MENAEXT/EXTMEDSTRPART/0,,contentMDK:22500563~pagePK:64168445~piPK:64168309~theSitePK:5147588,00.html
2010	Cost of Coastal Zone Environmental Degradation	Syria	http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/MENAEXT/EXTMEDSTRPART/0,,contentMDK:22500563~pagePK:64168445~piPK:64168309~theSitePK:5147588,00.html
2004	Cost of Environmental Degradation Lebanon and Tunisia – Report	Tunisia	http://siteresources.worldbank.org/INTMNAREGTOPENVIRONMENT/Resources/COEDCountryReportLebanon_Tunisia_Eng_French.pdf
2004	Cost of Environmental Degradation – Profile	Tunisia	http://siteresources.worldbank.org/EXTMETAP/Resources/COED-TunisiaCP.pdf
2004	Seawater and Brackish Water Desalination	Tunisia	http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2005/09/08/000160016_20050908163945/Rendered/PDF/335150v30Seawater0Annex20tunisia.p

			df
2007	Cost of Coastal Zone Environmental Degradation	Tunisia	http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/MENAEXT/EXTMEDSTRPART/0,,contentMDK:22500563~pagePK:64168445~piPK:64168309~theSitePK:5147588,00.html

ANNEX II - INTERNATIONAL BENEFIT TRANSFER ASSUMPTIONS: METHODOLOGICAL INSIGHTS

This annex discusses a dimension of international benefit transfer that can greatly influence estimated benefits - the use of market prices vs. purchasing power parities (PPP). In addition, the Annex includes a section that estimates the Value of Statistical Life (VSL) using the benefit transfer approach. The VSL can be used to estimate the benefit to society of mortality risk reductions from, for example, improvements in ambient air quality and improvements in drinking water quality, sanitation and hygiene.

- **Market Prices vs. PPP**

To understand the approach proposed for benefit transfers, consider two barter economies (this avoids a discussion of relative monetary prices and exchange rates). A willingness-to-pay (WTP) study was conducted in country T. Country T has a single 'good' barter economy in which the 'good' can be traded for environmental services. Each respondent's income in the WTP study is 10 'goods', and each individual's WTP for an environmental service is one 'good'.

This information is applied to estimate individuals' WTP for an identical environmental service in country P. Country P is also a barter economy with a single 'good' identical to the 'good' in Country T. Each individual in country P also has an income of 10 'goods'. They also have identical preference functions for 'goods' and environmental services as individuals in country T. Thus their WTP for the environmental service is also one 'good', and WTP is 10% of income in both countries (table A2.1).

Table A2.1. WTP in two barter economies with identical preferences

	Transfer Country (T)	Policy Country (P)	
Real income (GDP per capita)	10	10	goods
WTP	1	1	goods
WTP (% of real income)	10%	10%	

Let us now introduce money in these two countries (quantity of 'goods', and thus real income and preferences, are still the same) and consider international benefit transfers first using market prices and then PPP in the transfer function. Country T uses Euros as the medium of exchange. The price of the 'good', market exchange rate, and income in local currency units (LCU) and in Euros are presented in table A2.2.

Table A2.2. International benefit transfer using market GDP and exchange rates

	Transfer Country (T)	Policy Country (P)	
Price per good	1.0	0.5	LCU
Income (GDP per capita)	10.0	5.0	LCU

Market exchange rate	1.0	2.5	LCU/€
Income (at market exchange rates)	10.0	2.0	€
WTP (benefit transfer)	1.0	0.2	€
WTP (benefit transfer)	1.0	0.5	LCU
WTP (% of income)	10%	10%	

The transfer function, with identical preferences in both countries, is:

$$WTP_P = WTP_T (I_P / I_T) \quad (1)$$

where I_k is income in respective countries k=P, T. WTP in country P is then:

$$WTP_P = 1\ (2/10) = €\ 0.2 \text{ (or 0.5 LCU)} \quad (2)$$

Thus WTP is 10% of income in each country.

Let us now turn to international benefit transfer using PPP (table 3). Let us use the € as 'numéraire' currency so that PPP=1 in country T. PPP in country P is then 0.5/1.0=0.50 (the ratio of price of the 'good' in LCU of each country, from line 1 in table 2). We see then that PPP income in Euros are identical in the two countries (income in country P is 5 LCU / PPP = 10 €). Thus from equation (1), WTP = 1 € in both countries.

Now we have two options in converting the transferred WTP in country P into local currency (LCU). Converting using PPP results in a WTP = € 1 * 0.5 = 0.5 LCU which is 10% of income. Converting using market exchange rate results in a WTP = € 1 * 2.5 = 2.5 LCU which is 50% of income.

So which conversion to LCU in country P is correct? Converting using PPP gives WTP=10% of income in both countries and is thus consistent with the assumption that preferences are identical. Converting using market exchange rates suggests that individuals in country P are willing to forsake 5 'goods' for the environmental service (while individuals in country T forsake 1 'good'). This violates the assumption of identical preferences, given that income (measured in 'goods') is the same in the two countries.

Table A2.3. International benefit transfer using PPP GDP

	Transfer Country (T)	Policy Country (P)	
PPP	1.00	0.50	
PPP Income (PPP GDP per capita)	10	10	€
WTP (benefit transfer)	1.0	1.0	€
Converting to LCU using PPP			
WTP (benefit transfer)	1.0	0.5	LCU
WTP (% of income)	10%	10%	
Converting to LCU using market rates			
WTP (benefit transfer)	1.0	2.5	LCU

WTP (% of income)	10%	50%	

It should also be noted that if WTP in country P is to be expressed in LCU, it does not matter whether PPP or market prices are used in the benefit function (equation 1) when conversion to LCU uses PPP in table A2.3. That is, WTP in LCU is the same in both cases (which holds even if the two countries have different income level, provided that the income elasticity is equal to one). The only difference is when expressed in Euros (0.2 Euros when using market prices and € 1.0 when using PPP; from tables A2.2-3). The ratio 0.2/1.0 simply reflects the market price difference of the 'good' in the two countries.

Let us now consider the more general case of the transfer function with the income elasticity $\varepsilon > 0$. Then the transfer function is:

$$WTP_P = WTP_T \, (I_P / I_T)^{\varepsilon} \qquad (3)$$

Let us now see what happens to WTP as a percentage of income (WTP_P/I_P) with a change in income (I_P). This is given by taking the derivative of the WTP to income ratio with respect to income in equation (3):

$$\delta \, (WTP_P/I_P) \, / \, \delta \, I_P = WTP_T \, (1 / I_T)^{\varepsilon} \, (\varepsilon-1) \, I_P^{\varepsilon-2} \qquad (4)$$

which is = 0 for $\varepsilon=1$; < 0 for $\varepsilon<1$; and > 0 for $\varepsilon>1$. So in our case above (tables 1-3) with $\varepsilon=1$, WTP as a percentage of income (WTP/I) is the same regardless of income level. With $\varepsilon<1$, then WTP/I is smaller at higher income level and larger at lower income level. Thus WTP/I when we use PPP in the transfer function is smaller than WTP/I when we use market prices (because PPP adjusted income is higher than income at market prices in all ENPI countries). The opposite is the case with $\varepsilon>1$.

This is illustrated in figure 1 for the general case where income in country P is lower than in country T. The solid lines reflects ε =1 and the dotted lines reflect $\varepsilon<1$. The following can be concluded from figure A2.1:[47]

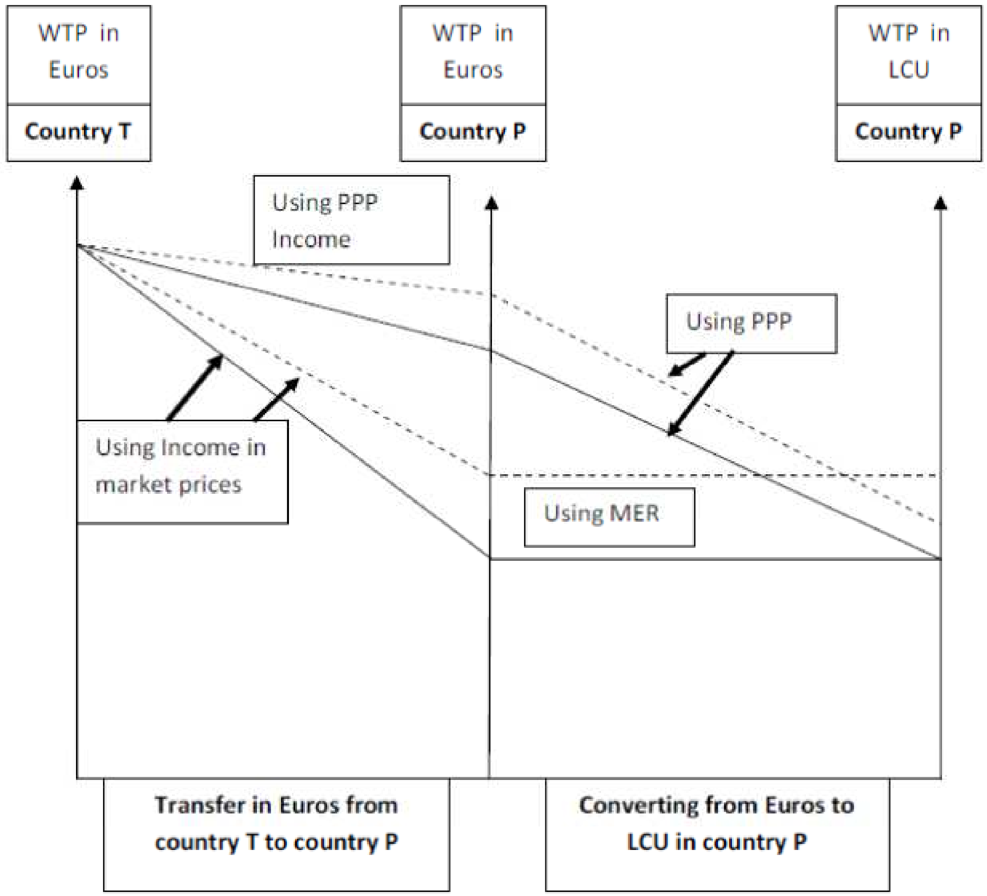
i) WTP_P stated in Euros is higher when using PPP than when using market prices in the transfer function for any given income elasticity.

ii) WTP_P stated in LCU is the same whether using PPP or market prices in the transfer function when the income elasticity is equal to one.

iii) WTP_P stated in LCU is always lower when using PPP than when using market prices in the transfer function when the income elasticity is strictly < 1.

47 The conclusions are valid when the price level in country P is lower than in country T, which is the case in all ENPI countries relative to the EU (or, more precisely, relative to the high income countries from where the WTP studies originate).

Figure A2.1. International benefit transfer using PPP and market prices



Note: PPP is purchasing power parity; MER is market exchange rate; LCU is local currency unit.

If we are to state WTP in country P in Euros using PPP, we need to be very transparent about this and explain what this means. Otherwise there is a risk that policy makers or researchers in this country may convert the WTP to LCU using market exchange rates and thus inflate WTP in LCU by a multiple equal to the price level difference between country T and P (in our example by a multiple of 5 in tables A2.2-3). Also, if benefits in country P are to be stated as a percentage of GDP based on Euros using PPP, then the correct measure of GDP to use is PPP adjusted GDP. This will be consistent with benefits as a percentage of GDP using LCU and GDP at market prices.

Application of benefit transfers using PPP also raises important issues of consistency in benefit assessment of environmental improvements. Consistency must be ensured across themes. Suppose that benefits of environmental improvements are to be stated in Euros using PPP. And suppose that PPP is used in benefit transfers of WTP for health, protected areas and biodiversity, recreational values etc. If so, shouldn't agricultural output losses from land degradation also be converted to Euros based on PPP? Agricultural output losses consist of both tradable and non-tradable crops. While tradable crop prices should reflect world prices (and world prices are applied for valuation of cereals), prices of non-tradable goods are likely to be far below prices of such crops in the EU (measured at market exchange rates). If the basket of tradable and non-tradable crop production and their domestic relative prices are similar to that in the overall economy, then the national PPP can be used to convert to Euros. This issue may also be important for benefit valuation of improved waste management. If such benefits are based on a percentage of household income, then they must be converted to Euros using PPP and not market exchange rates in order to be consistent with the WTP benefit transfers in the other themes.

- **The value of reduced mortality risk in ENPI countries: Estimates of the value of statistical life (VSL)**

Assessments of the benefits of environmental improvements that involve reduced risk of mortality are improvements in outdoor air quality and drinking water quality, sanitation and hygiene. Improvements in air quality are first and foremost found to reduce the risk of mortality among adults, while improvements in drinking water quality, sanitation and hygiene reduce the risk of mortality mostly among young children.

A value of statistical life (VSL) is often used to estimate the benefit to society of such mortality risk reductions:

$$VSL = WTP/r \quad (5)$$

where *WTP* is individuals' willingness-to-pay for a reduction in risk of mortality and *r* is the size of the risk reduction.

Studies of WTP for a reduction in risk of mortality have been carried out in numerous countries, but there are few, if any, such studies from ENPI countries. A commonly used approach to estimate VSL in this case is benefit transfer (BT) based on meta-analyses of WTP studies from other countries. Several meta-analyses have been conducted in the last decade (e.g. Mrozek and Taylor 2002; Viscusi and Aldy 2002; Kochi et al 2006; Navrud and Lindhjem 2010). Meta-analyses assess characteristics that determine VSL such as household income, size of risk reduction, other individual and household characteristics and often characteristics of the methodologies used in the original WTP studies.

The meta-analysis by Navrud and Lindhjem (2010), prepared for the OECD, is exclusively based on stated preference studies and relies on a database of more than 1000 VSL estimates from multiple studies in over 30 countries, of which nearly half have a GDP per capita in the range of that of the ENPI countries (www.oecd.org/env/policies/VSL). These studies better allow for inclusion of adult age groups in society that often are most affected by environmental risk factors. These studies also allow for an assessment of the influence of latency in mortality risk on VSL.[48] Navrud and Lindhjem provide an empirically estimated BT function from the stated preference studies that can be readily applied to estimate VSL in ENPI countries:

$$\ln(VSL) = 0.0433 + 1.022 \ln(gdp) - 0.445 \ln(r) \qquad (6)$$

where *VSL* is expressed in purchasing power parity (PPP) adjusted US$; *gdp* is GDP per capita in PPP adjusted US$; and *r* is the change in risk of mortality. This BT function implies that the income elasticity is 1.022.

Applying this BT function involves specifying change in mortality risk (r). The change in mortality risk from environmental improvements varies across environmental issues. Improvement in air quality is most often achievable only over an extended period of time through multiple interventions that each provides only a marginal change in air quality and reduction in mortality risk. Thus it seems most appropriate to apply a change in risk in (6) that is at the lower end of the risk changes commonly used in WTP studies i.e. an annual change of 1/10,000. Thus (6) becomes:

$$VSL = e^{(4.1419+1.022\, ln(gdp))} \qquad (7)$$

Applying this risk change and purchasing power parity adjusted GDP per capita in 2008 and projected for 2020 provides the estimates of VSL used in this study. These are presented in chapter 5 in Table 5.7.[49]

In perspective, estimated VSL for the high-income OECD and the €-zone countries in 2008 using equation (6) is about € 1.9 and 2.05 million (PPP adjusted), respectively, reflecting PPP adjusted GDP per capita of € 24,000-26,000. The estimated VSL at market exchange rates in 2008 for the same groups of countries is € 2.2 million, reflecting a GDP per capita of € 28,200.[50] These estimates are about the same as the upper end of the range of VSL of € 1-2 million suggested in European Commission (2009) based on a set of studies in European Union countries some years ago. Adjusting these EC values to 2008 by changes in income and prices gives a range of VSL within which estimates for high-income OECD and €-zone countries fall using equation (6).

The meta-analyses of VSL cited above are based on studies of WTP for reduction in mortality risk pertaining to the adult population. There are, however, also studies that have assessed adults' or parents' WTP for reduction in children's risk of mortality. Some, but not all of these studies find this WTP to be substantially higher

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48 Navrud and Lindhjem find no statistically significant impact of latency on VSL.

49 PPP adjusted US$ are converted to PPP adjusted Euros at an exchange rate of US$ 1.464 per € and to local currency units (LCU) using PPP. PPP adjusted GDP per capita in 2008 figures are from World Bank (2010) and projected PPP adjusted GDP per capita in 2020 is discussed elsewhere in this document.

50 GDP per capita figures are from World Bank (2010).

than WTP for adult mortality risk reduction (OECD, 2010). These studies are mostly, if not exclusively from countries with very low child mortality rates and very low risks of dying from environmental factors.

Improvement in a household's drinking water quality, sanitation, and hygiene practices can change substantially over a short period of time through connection to high quality piped water, improvement in drinking water treatment, improvement of existing piped water networks, upgrading of toilet facilities and connection to sewage networks and promotion of good hygiene. Reduction in risk of mortality from these improvements is substantially larger for children than for adults. In light of child mortality rates and drinking water quality and sanitation status in ENPI countries, these improvements can reduce the annual risk of mortality among young children in targeted households by an order of 1/10,000 to 10/10,000, which is generally a much larger reduction in mortality risk than implied by incremental improvements in air quality and studies of VSL for children reviewed in OECD (2010). The reduction in risk that one or more children die in a household over the time period that a household has young children is also influenced by female fertility rates. Total fertility rates in 2008 varied from 1.4-1.6 children per woman in most eastern ENPI countries (1.7 in high income OECD countries) to 2.4-3.5 children in most southern ENPI countries (World Bank, 2010). The total reduction in mortality risk per household from environmental improvements in the southern ENPI countries is therefore, ceteris paribus, substantially larger than in high-income OECD countries.

Thus, while some studies indicate a substantially higher VSL for children than for adults in countries with very low child mortality risk, the relatively significant reduction in risk of mortality from environmental improvements in households in many ENPI countries – possibly compounded by higher total fertility rates in many of them – suggests a lower VSL for children than indicated by OECD (2010). The VSL applied to children in this study is therefore the same as for adults.[51]

[51] For instance, the difference between a VSL for children that is twice as large as presented in table 4 is entirely off-set by a mortality risk reduction of 5/10,000 instead of 1/10,000.

ANNEX III – FURTHER DETAILS ON THE METHODOLOGY FOR AMBIENT AIR QUALITY

This Annex describes in more detail the assessment for ambient air quality.

Quantitative and monetary assessment

The four categories of pollution impacts that we quantify are:

- Premature deaths avoided (mortality).
- Illness avoided (morbidity) – e.g. bronchitis[52], asthma.
- Crop damage avoided.
- Material damage avoided.

One reason why our estimates of benefits are likely to be under-estimates of the true benefits of compliance with tighter regulation is that we are not presently able to quantify the benefits associated with the following impacts avoided:

- Impacts on ecosystems.
- Change in biodiversity.
- Potential effects of chronic exposure to ozone.
- Impacts on cultural heritage and monuments.
- Material soiling.
- Direct and indirect economic effects of change in forest productivity, and fishery performance.

Nevertheless, we would suggest that those impacts that we can quantify are likely to represent a significant - and majority - share of the total impacts in welfare (monetary) terms.

The categories of pollution that we are able to quantify will make use of the dose-effect models that have been compiled and critically reviewed in the ExternE series of projects, most recently in the NEEDS project[53]. See the ExternE methodology report [European Commission 2005] and the NEEDS deliverables for a more detailed discussion. A summary of the quantified relationships are given in the table below. Note that linear dose-effect relationships will be used to derive the central results. Log-linear relationships may be used in sensitivity analysis. The results use modelled pollution concentration levels. The effects of actual measured levels may be discussed alongside the results.

52 Benefits include the benefit to the individual of not incurring the illness, and also benefits of reduced hospitalisation days and reduced-activity days.

53 http://www.needs-project.org/

Table A3.0.1. Health and Environmental effects quantified in the air quality assessments

Impact Category	Pollutant	Effects
Human Health – mortality	PM_{10} [a]	Reduction in life expectancy due to exposure
	SO_2, ozone	Reduction in life expectancy due to long time exposure
Human Health – morbidity	PM_{10}, ozone	Respiratory hospital admissions
		Restricted activity days
	PM_{10}	Cerebrovascular hospital admissions
		Congestive heart failure
		Cases of chronic bronchitis
		Cases of chronic cough in children
		Cough in asthmatics
		Lower respiratory symptoms
	O_3	Asthma attacks
		Symptom days
Building Material	SO_2,acid deposition	Ageing of galvanised steel, limestone, mortar, sandstone. paint, rendering, and zinc for utilitarian buildings
Crops	SO_2	Yield change for wheat, barley, rye, oats, potato, sugar beet
	Ozone	Yield change for wheat, barley, rye, oats, potato, rice, tobacco, sunflower seed
	Acid deposition	Increased need for liming
	N, S	Fertilising effects

[a] particles with an aerodynamic diameter < 10 µm, including secondary particles (sulphate and nitrate aerosols), therefore including $PM_{2.5}$

The mortality impacts of the pollution emission reductions will be expressed in terms of number of premature deaths avoided. Morbidity impacts are of a disparate nature and so cannot be expressed as a common unit. However, for illustration, the morbidity impacts are presented as equivalent number of cases of chronic bronchitis avoided. The monetisation of mortality is based on the VSL listed in Chapter 5.5.2.

Units for materials and crop damages are not as readily meaningful and we cannot present these here. However, in the case of materials, the impact being quantified is the premature ageing of various building materials exposed to SO_2 deposition from acidification. Thus, in our context, the whole exposed material surface area to SO_2 will age at a slower rate than if the Directives were not to be implemented.

Crop damage is measured primarily by the change in yield that results from the change in pollutant concentrations in the air. Thus, with knowledge of the geographical distribution of crop plantations within a country, the acreage of a given crop affected by a change in pollutant concentration can be estimated and the percentage yield change can be derived.

ANNEX IV – FURTHER DETAILS ON THE METHODOLOGY FOR ASSESSING THE HEALTH BENEFITS FROM REACHING DRINKING WATER, SANITATION AND HYGIENE TARGETS

This annex provides additional insights on the approach to carry out some of the calculations related to sewage and hygiene benefits.

Inadequate potable water supply, sanitation and hygiene (WASH) causes disease and mortality. Reaching WASH targets is therefore expected to provide health benefits in terms of reduced incidence of disease and mortality.

Expected health benefits can be estimated in two stages. Nationwide annual incidence of disease and mortality resulting from baseline WASH situation in a target year (e.g. 2020) is estimated in the first stage. The baseline WASH situation in 2020 corresponds to a business-as-usual (BAU) situation, for instance the situation that would prevail if no additional efforts are undertaken to improve WASH from the reference year (e.g. 2008) to the target year (e.g. 2020). Health benefits or reduced incidence of disease and mortality from reaching the 2020 targets are estimated in the second stage.

Baseline disease and mortality in 2020

Directly, inadequate WASH causes diarrheal infections and other health effects which in turn lead to mortality especially in young children. Indirectly, inadequate WASH contributes to poor nutritional status in young children through the effect of diarrheal infections.[54] Poor nutritional status in turn increases the risk of child mortality from disease (Fishman et al., 2004). Prevalence of underweight children under the age of five is the nutritional indicator most commonly used in assessing the risk of mortality from poor nutritional status (Fishman et al., 2004).

Estimation of the direct health effects of inadequate WASH is here restricted to diarrhoea in all population age groups and diarrheal mortality among children under five years of age. This restriction is due to data limitations, that diarrhoea constitutes the predominant share of the disease burden from inadequate WASH, and that over 90 per cent of diarrheal mortality is generally found to be among children under five years of age.

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54 Repeated infections, and especially diarrheal infections, have been found to significantly impair weight gain in young children. Studies documenting and quantifying this effect have been conducted in communities with a wide range of infection loads in a diverse group of countries (Black et al., 1984; Bairagi et al., 1987; Becker et al., 1991; Rowland et al., 1977; Rowland et al., 1988; Martorell et a.l, 1975; Molbak et al, 1997; Kolsteren et al., 1997; Condon-Paoloni et al., 1977; Checkley et al., 1997; Adair et al., 1993; Zumrawi et al., 1987; Villamor et al., 2004). World Bank (2008) provides a review of these studies.

Annual incidence of diarrhoea in 2008 can be estimated from national household surveys such as DHS and MICS for children under the age of five years.[55]
Annual incidence among the population five years and older in 2008 may be assumed to be 1/5th of the incidence among children under five based on available evidence from household surveys of all population age groups. Baseline 2020 annual incidence of diarrhoea per person may be assumed to be the same in 2020 as in 2008 if the baseline WASH situation assumes no change in WASH from 2008 to 2020. Thus annual cases of diarrhoea from WASH are estimated as follows:

$$W_D = \sum_{i=1}^{i=2} P_i \alpha_i AF_d \qquad (1)$$

where P_1 is the population of children under five years of age, P_2 is population five years and older, α_i is annual diarrheal incidence per person in each population group, and AF_d=0.88 is the global attributable fraction of diarrhoea caused by inadequate WASH (Pruss et al., 2002; Pruss-Ustun et al., 2004).

Annual cases of diarrheal mortality among children under five years of age from WASH are estimated as follows:

$$W_M^D = C\beta_d AF_d \qquad (2)$$

where C is annual live child births, β_d is mortality from diarrhoea among children under five years (per 1,000 live births), and AF_d=0.88 is global attributable fraction of diarrhoea caused by inadequate WASH. Child mortality from diarrhoea per 1,000 live births in 2008 can be taken from WHO (2010) or country statistics and may be assumed to be the same in 2020 if the baseline WASH situation assumes no change in WASH from 2008 to 2020.

Estimating the indirect health effects of diarrhoea from WASH is undertaken in two steps. First, the fraction of mortality among children under five years attributable to child underweight is estimated. This follows the methodology in Fishman et al. (2004). Second, a fraction of mortality among children under five years from underweight is attributed to diarrheal infections from WASH in early childhood using the approach in Fewtrell et al. (2007).

Estimates of increased risk of cause-specific mortality in children under five years of age with mild, moderate and severe underweight is presented in table A4.1 based on Fishman et al. (2004).

Table A4.1. Relative risk of mortality from severe, moderate and mild underweight in children under five

	Severe	Moderate	Mild	None
Diarrhoea	12.5	5.4	2.3	1.0
ALRI	8.1	4.0	2.0	1.0
Measles	5.2	3.0	1.7	1.0
Malaria	9.5	4.5	2.1	1.0

55 See www.measuredhs.com and www.childinfo.org.

	Severe	Moderate	Mild	None
Other causes of mortality*	8.7	4.2	2.1	1.0

*Source: Fishman et al. (2004). ALRI is acute lower respiratory infections. Relative risks are in relation to nutritional status according to the NCHS international reference population. * Only other infectious diseases (except HIV) are included here (see Fewtrell et al., 2007).*

These relative risk ratios are applied to prevalence of child underweight to estimate attributable fractions (AF_j) of mortality by cause, *j*, from child underweight as follows:

$$AF_j = \frac{\sum_{i=1}^{n} P_i (RR_{ji} - 1)}{\sum_{i=1}^{n} P_i (RR_{ji} - 1) + 1} \qquad (3)$$

where RR_{ji} is relative risk of mortality from cause, *j*, for children in each of the underweight categories, *i*, in table 1; and P_i is the underweight prevalence rate among children under the age of five. Prevalence rates of moderate and severe underweight can be taken from data published in nutrition survey reports, DHS or MICS reports conducted in the country (see www.childinfo.org). Prevalence of mild underweight is however most often not published in these reports but can be estimated from the original survey data of nutrition studies, DHS or MICS surveys. Prevalence rates of underweight children under the age of five underweight in t in the target year (e.g. 2020) can be assumed to be the same as at the time of the most recent nutrition study or DHS and MICS survey, or adjusted as deemed appropriate.
Annual cases of mortality from child underweight (by cause, 'j', in table A4.1) are estimated as follows:

$$M_j = C\beta_j AF_j \qquad (4)$$

where C is annual live child births, β_j is under-five child mortality from cause 'j' (per 1,000 live births), and AF_j is from equation 3. Cause specific mortality per 1,000 live births in 2008 is taken from WHO (2010) and can be assumed to decline from 2008 to 2020 at a rate deemed appropriate.

Annual cases of indirect mortality among children under five years of age from WASH are then estimated as follows:

$$W_M^I = \sum_{j=1}^{j=m} \gamma_j M_j \qquad (5)$$

where γ_j is the fraction of child underweight mortality, M_j, attributed to WASH caused by diarrheal infections in early childhood. WHO (Fewtrell et al., 2007) uses γ_j = 0.5 for ALRI, measles, malaria and 'other infectious diseases', which is applied here. As 88 per cent of cases of diarrhoea are globally attributed to WASH, the additional indirect effect through child underweight on diarrheal mortality is therefore minimal and ignored here (i.e., γ_1=0) .

Total estimated annual cases of mortality from WASH are thus:

$$W_M = W_M^D + W_M^I \quad (6)$$

Health benefits in 2020 of reaching the targets

In order to estimate the health benefits of reaching WASH targets, the national population is divided into four groups reflecting their current status of water supply, sanitation and hygiene practices (see chapter 7.1.1 and 7.1.2). Each population group can benefit from up to three WASH improvements. These WASH improvements are expected to provide a certain percentage reduction in diarrheal disease and mortality, r_i, in each population group P_i. The expected diarrheal disease and mortality reductions can be based on adaptations of findings reported in Arnold and Colford (2007), Clasen et al. (2007), Fewtrell et al. (2005), and Curtis and Cairncross (2003) and can be converted to relative risks of disease and mortality as follows:

$$RR_i = 1 / (1- r_i) \quad (7)$$

The relative risks in table A4.2 correspond to the disease and mortality reduction rates that are used in chapter 7.1.2.[56]

Table A4.2. Relative risks of disease and mortality by population group

	Relative risk ratio (RR)	
Population distribution	Assuming already good hygiene	Substantial scope for hygiene improvement
P_1	1.18	1.82
P_2	1.54	2.86
P_3	1.33	2.22
P_4	1.82	4.00

Source: Estimates by authors.

The nationwide percentage of diarrhoea and mortality that is expected to be avoided by reaching the WASH targets is given by the attributable fraction formula:

$$AF = \frac{\sum_{i=1}^{i=4} P_i (RR_i - 1)}{\sum_{i=1}^{i=4} P_i (RR_i - 1) + 1} \quad (8)$$

Annual benefits in terms of avoided annual cases of diarrhoea (B_D) and mortality (B_M) are then estimated as:

$$B_M = (W_M^D / 0.88 + W_M^I) AF \quad (9)$$

$$B_D = (W_D / 0.88) AF \quad (10)$$

56 These relative risks are risks of disease and mortality relative to risks of disease and mortality that are expected after the WASH improvements or targets are achieved.

ANNEX V - DETAILED METHODOLOGY FOR THE ASSESSMENT OF THE BENEFITS FROM THE IMPROVEMENT OF SURFACE WATER QUALITY

This note outlines a methodology for the estimation of the non-market economic value of a change in water quality. The benefit function transfer method is applied for the estimation of monetary benefits per country for an improvement in water quality related to the definition of 'Good Ecological Status', which builds on the overarching environmental objective of the EC Water Framework Directive (WFD).

Most of the non-market social benefits associated with water quality improvements (e.g. recreation) do not have a market value or a price. The objective of this valuation is therefore to find alternative ways to assign monetary values. This can be done either by finding substitute market values or by directly asking people for their willingness to pay for the enhanced services provided. As substitute markets are difficult to find for ecological improvements in water quality, and the elicitation of primary benefits data can be costly and time consuming, this methodology focuses on transferring the benefits functions found through primary valuation in other locations to the countries under analysis.

In the ENPI project the benefits function transfer (BFT) method built on an original valuation study conducted in England and Wales (Baker et al., 2007). This study estimated the economic value placed by English and Welsh households on water quality improvements at local and national level as a result of implementing the EC Water Framework Directive. It is one of a few studies in Europe that has employed a standard WFD ecological-based water quality metric for description of baseline levels and improvements.

Methodology

Unlike direct transfer of benefits estimates between locations, the BFT method allows the incorporation of differing socio-economic and site quality characteristics between the original study site and the policy site under evaluation. In this type of benefit transfer typically only one original valuation study is selected - the main assumption being that the statistical relationship between WTP for improvements and independent variables are the same for both the study and policy site. In other words, BFT applications assume that preferences/tastes are the same between both locations and differences are only related to differences in socio-economic and/or environmental context variables.

Unlike unadjusted BT exercises where mean WTP at the policy site is assumed to be equal to mean WTP values at the original site ($WTP_S = WTP_P$), BFT exercises attempt to adjust values by accounting for any possible differences (e.g. socio-economic and environmental quality variables included in the aggregated benefits function) between both sites; see Bateman et al. (2000) or Garrod and Willis (1999). Equation 1 offers a conceptual representation of the benefit function transfer approach:

$$\text{Survey site: } WTP_S = \alpha_s + \beta_{s1}X_{s1} + \beta_{s2}X_{s2}$$
$$\Updownarrow \qquad (1)$$
$$\text{Policy site: } WTP_P = \alpha_s + \beta_{s1}X_{p1} + \beta_{s2}X_{p2}$$

Where s denotes the survey site, p the policy site and X_1, X_2 vectors of specific good characteristics and population characteristics for each site (e.g. income and education levels, baseline water quality levels...).

The study by Baker et al. (2007) has recently estimated the economic value placed by English and Welsh households on water quality improvements at local and national level as a result of implementing the Directive. It is one of few studies that employed a standard WFD ecological-based water quality metric for description of baseline levels and improvements. The results of this research are being used by DEFRA (Department for Environment, Food and Rural Affairs) and the Environment Agency in England and Wales to inform policy decisions necessary to comply with the Directive[57].

The DEFRA study offers detailed results for three different WTP methods in the same survey instrument: Contingent Valuation (CV) using both payment card (PC) and dichotomous choice (DC) as payment mechanisms and Choice Experiments (CE).

The report models can be used to derive aggregate values for WFD environmental improvements scenarios by attaching values to each of the variables employed in the PCCV and DCCV models and multiplying through by the respective coefficients.

In the PCCV OLS model, the sum of the coefficients multiplied by the values of the variables they correspond to yields the conditional mean of the log of WTP, as this is the dependent variable in the model (the authors found that the model with ln_wtp as the dependent variable fits the data substantially better than the model with WTP as the dependent variable – this is standard practice in the CV literature). The exponential of this value, as illustrated by Goldberger (1968), gives the conditional median rather than the mean WTP estimate. Alternatively, the conditional mean can be derived by applying an adjustment equal to the mean of the exponential of the residuals from the model (Baker et al., 2007).

For the Logit DCCV model, the results can be used to derive mean WTP estimates for the '95% overall improvement scenario' by applying formula (2), which is the linear random utility expression of mean WTP for parametric logit models (Haab and McConnell, 2002). In this expression, β is the coefficient of the bid variable (dc_bill), which was divided by a 100. α is a vector of the means of all variables and zj is a vector of all estimated coefficients. In linear random utility, preference uncertainty (ε) is symmetric (assumes homogeneity in the population) with mean zero which

57 DEFRA: Overall Impact Assessment for the Water Framework Directive in England and Wales http://www.defra.gov.uk/environment/water/wfd/pdf/RIA-river-basin-v2.pdf

means that mean and median WTP values with respect to random preferences are equal (Haab and McConnell, 2002).

$$E_{\varepsilon}(WTPj|\alpha, \beta, z_j) = 100 * \frac{-\alpha z_j}{\beta_{dc\_bill}}$$

Basic assumptions

The methodology builds on the following aspects and assumptions:

- BFT is regarded as a suitable tool for the adjusted transfer of WTP estimates between different locations when the vector of attributes and socio-economic characteristics (X1, X2) that determine the similarities and differences between the policy and the survey site can be established. Where these differences exist and their magnitudes are known, it is possible to substitute those known variables into the survey site's original aggregated benefits function to provide valid BT estimates. This exercise involves the choice about which factors are included and which are omitted in the analysis, which is usually limited by data availability.
- The method assumes that the relationship between the independent variables and the dependent variables in the model are the same across the countries under analysis. In other words, household preferences for water quality improvements are considered homogenous across locations.

General parameters

Variables that must be predefined in the transfer of Baker et al. (2007) benefit functions are:

- Current fresh water quality levels in each country
- Household socio-economic statistics (income, education, gender composition)
- Desirable but not essential data: Water use statistics

These parameters are used in the formulas above to calculate annual Willingness to Pay (WTP) for set improvements in freshwater quality per household per year.

The reference level

The data needed for transferring the Baker et al. (2007) functions between countries are outlined below. Mean values for each of the relevant variables would be needed. The table highlights those variables which can be adjusted from the original model. Other variables need to be kept fixed, as these are also fixed in the original model. These mainly comprise survey control instruments for the valuation exercise. In addition, the system allows the introduction of different degrees of transformation depending on the availability of data. Higher degrees of transformation would imply that the benefit function transfer exercise would capture to a greater extent the characteristics of the policy site in relation to the survey site. If a lesser degree of transformation is introduced, the function transfer is still possible.

Summary of data needs:

1. Variations in the high water quality levels in local areas. This variable reflects improvements in relation to baseline water quality levels by river basin district/country.
2. Number of households (divided by rural/urban areas and linked with income categories)
3. Income per household (divided by rural/urban areas)
4. Number of children per household
5. Survey results on use of water resources in the country
6. Survey results on attitudes towards pollution control
7. Male/Female ratio
8. Education levels in the country. Ideally divided between no education, those who leave education before 16 years old and those who complete the whole schooling system and go into further education (above A levels).
9. Membership numbers to water related activities (same as water use)

Modelling

The modelling is done in Excel. It is based on the collected basic data and the general parameters of the benefit functions.

Baseline/counterfactual

Different countries may have already defined their own water quality targets and may organise themselves in order to reach these targets somewhere between now and the target year (e.g. 2020) and beyond. Some countries may be even aiming to match the targets of the European water policy, such as the achievement of Good Ecological Status (GES) for all surface water (e.g. Ukraine). For the transfer of benefits functions we do not consider changes in water quality management policy between now and the target year, but assume that existing policy is driven by the EC Water Framework Directive and the objective of no deterioration in quality and achievement of GES. This means that the baseline scenario is equal to the current water quality levels in the countries.

The DEFRA approach can be applied as long as the percentage of freshwater units (river length or surface area for lakes) that would fall into each water quality category as used in Baker et al. (2007) (high, medium, low) per country is known. WFD water quality labels are easy to translate to other areas outside Europe, as we could focus on finding out the single limiting quality element per country (Phosphorus, Nitrogen, FIO or other water pollutants for which data may be available in the country). The table below outlines the water quality labels used in the DEFRA study and how they relate to the WFD normative quality labels. As a minimum requirement for information, we would need to know the percentage of unpolluted rivers and lakes.

<table>
<tr><th>DEFRA study water quality labels</th><th>Description</th><th>WFD quality labels</th><th>Data needs</th></tr>
<tr><td>High quality</td><td>High or Good Ecological Status (natural water bodies); Maximum or Good Ecological Potential (artificial or heavily modified water bodies)</td><td>High Status

Good Status</td><td rowspan="3">Per cent low, medium and high quality in national area at time=0
For the transfer exercise, we only need the % in the high quality (high and good) category. This can be the % of unpolluted rivers.
The unit adopted to measure the ‘quantity’ of each status level is hectares of catchment area for rivers, and hectares of surface water area for lakes, estuaries and coastal areas.
Alternatives considered included the number of sites, as defined by the WFD, and a metric combining the surface water area for lakes, estuaries and coastal areas, with an approximation to river water surface area, based on kilometres of river.</td></tr>
<tr><td>Medium quality</td><td>Moderate or Poor Ecological Status (natural water bodies); Moderate or Poor Ecological Potential (artificial or heavily modified water bodies)</td><td>Moderate Status

Poor Status</td></tr>
<tr><td>Low quality</td><td>Bad Ecological Status (natural water bodies); Bad Ecological Potential (artificial or heavily modified water bodies)</td><td>Bad</td></tr>
</table>

Targets

In the ENPI study the target adopted was the compliance with the EU WFD. WTP for values as presented in Baker et al., (2007) are based on permanent increases in real annual payments (increase in water bills and other expenses) that a household is willing to pay for a scenario of 95% improvement to High Quality Status by 2015 for all surface water bodies in the country.

Benefit assessment

Aggregation of benefits for the policy analysis for each country would be possible under the following assumptions:

- constant annual linear improvements towards the objectives (e.g. up to 2020) accounting for freshwater resources and household geographical distribution;
- Future household projection numbers can be used to adjust household number figures in relation to expected forecasts of household occupancy.

ANNEX VI - CHECKLIST OF KEY INFORMATION

This checklist was developed for the ENPI assessment and was meant to guide the collection of information for the benefit study, either through a literature review, country missions or personal contacts with relevant experts/government institutions. It is meant to provide evidence of the information available, as well as clarify what is not available.

It is a fairly comprehensive list of information and it is expected that not all issues can be covered / data may be scarce in some areas. BAs should focus on the information available. Future benefits assessment carried out in countries may well adopt a wider or different set of parameters than focused on in the ENPI study and choose also different scenarios and sensitivities, and eventually also methods and models. The checklist below should therefore be seen as a useful starting point to be adapted by countries in light of their specific interests and contexts.

Keys:

- **Unit:** when possible, units to be used are specified (e.g. hectares, tons, per year, per capita etc.). If other units have been used please clarify.
- **Source:** when possible, useful international sources of information are indicated (e.g. FAO, World Bank data etc.)
- **Comments:** when useful, some clarification on the type of data required are provided

A. GENERAL ECONOMIC/DEMOGRAPHIC DATA

	Socio-economic data	Unit	Source	Comments
1	**Country surface area**	Km^2	World Bank	
2	**Population size**	#	World Bank	Urban & Rural & Total
a	Population density	# per km^2	World Bank	
b	Population in largest cities	#	World Bank	
c	Population projections to 2020/30	#	World Bank	
d	Population ages 0-4	% of total	World Bank	Male & Female
e	Population ages 0-14	% of total	World Bank	
f	Population ages 15-64	% of total	World Bank	
g	Population ages 65 and above	% of total	World Bank	
3	**Population growth rate**	%	World Bank	Urban & Rural & Total
a	Crude birth rate	Per thousand people	World Bank	
b	Crude death rate	Per thousand people	World Bank	
4	**Age dependency ratio**	% of working-age population	World Bank	
5	**Education levels in the country**	/	/	/
a	Literacy rate, adult total	%	World Bank	people aged 15 and above
b	School enrolment, secondary	% gross	World Bank	
c	School enrolment, secondary	% net	World Bank	

d	School enrolment, tertiary	% gross	World Bank	
6	**Number of households**	#	DHS/MICS/ PAPFAM	
a	Average households size	#	DHS/MICS/ PAPFAM	
b	Total fertility rate	#	World Bank	
c	Male/Female ratio	Ratio	World Bank	
7	**GDP**			
a	GDP (current)	US$	World Bank	
b	GDP growth	Annual %	World Bank/OECD	
c	GDP per capita (current)	US$	World Bank	
d	GDP per capita, PPP (current international $)	$	World Bank	
e	GDP, PPP (current)	$	World Bank	
f	GDP (current)	LCU	World Bank	
g	PPP conversion factor (GDP) to market exchange rate ratio		World Bank	
h	GDP per capita (market price)		World Bank	GDP at official exchange rate
i	Income per capita	€		Urban & Rural
j	Income per household	€	National data or World Bank	If at all possible make a distinction between urban and rural
8	**Employment by (main) economic sector (agriculture, industry, services, tourism, others if relevant)**	# or %		Note any insights on possible future developments if available
9	**Official exchange rate (€)**		Website OANDA	www.oanda.com
10	**Contribution to GDP of key economic sectors:**	/	/	/
a	Industry	% GDP	World Bank	
b	*Fishery*	% GDP		
c	Agriculture	% GDP	World Bank	
d	*Forestry*	% GDP		
e	Services	% GDP	World Bank	Residual from industry and agriculture
f	*Tourism*	% GDP		
g	Other subcategories if relevant	% GDP		
h	International tourism, number of arrivals	**#**	World Bank	
i	International tourism, receipts	**US$**	World Bank	
11	**Health**	/	/	/
a	Child mortality rate (CMR)	per 1,000 live births	World Bank	National
b	Diarrhoeal mortality rate	‰	WHO	For water
c	Diarrhoeal disease rate (children u5 yrs)	%	DHS/MICS	For water
d	ALRI mortality rate	‰	WHO	For indoor air
e	ALRI disease rate (children u5 yrs)	%	DHS/MICS	For indoor air

B. AIR

	AIR	Unit	Source	Comments
	SUB-THEME: Air quality			
	PARAMETER: Ambient air quality			
1	**Key problems/issues related to air quality (exposure to ambient air quality, impacts such as acidification, on buildings, etc.)**	-		A qualitative overview - add any insights on cases concerning urban air quality (e.g. which cities have major

	AIR	Unit	Source	Comments
				problems, in which period of the year etc)
2	**Emissions concentrations:** – **per year current** – **If available: trends**	/	/	If concentrations not available – use total emissions and specify that you've used total emissions.
a	NO_X	µg/mg or Mt		National & 2-3 main cities
b	SO_2	µg/mg or Mt		National & 2-3 main cities
c	Concentrations of PM_{10}[58]	µg/m³ or Mt		National & 2-3 main cities
d	Population weighted PM_{10}	µg/m³	World Bank	Data from cities with more than 100 thousands inhabitants
e	$PM_{2.5}$	µg/mg or Mt		National & 2-3 main cities If available (not monitored in some countries)
f	CO	µg/mg or Mt		National & 2-3 main cities
g	Ozone	µg/mg or Mt		National & 2-3 main cities
3	**Emissions sources (point sources e.g., industry and energy; non point e.g., transport[59])**	-		Note which are the main sources, add statistics on their contribution to national emission levels if available
4	**Emission charges, if any**	/	/	/
a	% or total amount of industrial emission charged	% or #		
b	Average emission charges and/or total revenues from charges	€		
5	**Vehicles**	/	/	/
a	Motor vehicles	per 1,000 people	World Bank	
b	Passenger cars	per 1,000 people	World Bank	
6	**Cause specific mortality rates (cardiopulmonary, lung cancer) in adults 30+ yrs**	% of all deaths all ages	WHO	For outdoor air
7	**Indoor air pollution**	/	/	Only useful for countries where indoor air pollution is an issue
a	Population use of solid fuels for cooking (%)	%	DHS/MICS	Only some countries
b	Open stove or fire with no chimney or hood	%	DHS/MICS	Only some countries
8	**Population size in individual administrative districts.**			If available

58 A mixture of fine ($PM_{2.5}$ or a particulate with a diameter of 2.5 micrometers) and respirable (PM_{10} with a diameter of 10 micrometers) solid particles and liquid droplets found in the air. Fine particulates are small enough to penetrate deeply into the lungs and could lead to chronic obstructive pulmonary diseases (COPD) and possibly cancer. Chemical substances may adhere to or be incorporated into these particulates. The latter could also be electrically charged by electric magnetic fields and increase the chances of cancer.

59 Note in some cases transport can also be a point source e.g. ships in ports constitute an increasing point source of pollution.

	AIR	Unit	Source	Comments
9	**Concentrations at national/ city level**			If available
a	SO_2			
b	CO			
c	NMVOCs			
d	O_3			
e	NO_2			
f	Pb			
10	**Data on the share of population belonging to the following risk groups for the whole country.**	%		
a	Population size under 18	%		
b	Asthmatics	%		
c	Over 18s	%		
d	All cause death rate per year	%		
e	Total	#		
f	Population over 65	%		
g	Asthma in children	%		
h	Asthma Adults	%		
i	Male	%		
j	Female	%		

C. WATER

	WATER	Unit	Source	Comments
	Key issues/problems related to water	-		A qualitative overview (e.g. water scarcity, pollution from specific source, significant loss of tourism, health impacts etc.)
	SUB-THEME: Water Infrastructures			
	PARAMETER: Connection to safe drinking water			
1	**Population with improved water supply (population with access)**	%	WHO/UNICEF JMP	Total, Urban & Rural
a	Piped water supply	%	WHO/UNICEF JMP	Total, Urban & Rural
b	Other improved water sources	%	WHO/UNICEF JMP	Total, Urban & Rural
c	Population with pre-treated piped water (municipal treatment) with good quality at tap	%		Total, & Urban
2	**Population with unimproved water supply**	%	WHO/UNICEF JMP	
3	**Water supply interruptions**			Only if it is an issue, and if information easily available
4	**Household appropriately treating drinking water**	%	DHS, MICS	
a	Households not treating drinking water	%	DHS, MICS	
5	**concentration of: lead, pesticides, nitrates, mercury, sodium, chlorides, e.coli, total coliform in drinking water**	mg		(if available at national/large cities level)
a	Organic water pollutant (BOD) emissions	kg per day	World Bank	
6	**Water charges, if any**	/	/	/

	WATER	Unit	Source	Comments
a	Population charged for water supply	% or #		
b	Average water charges and/or total revenues from charges	€		
	PARAMETER: Connection to sewage network & personal and households hygiene			
7	**Connection to sewerage systems**	/	/	/
a	Population with improved sanitation facility	%	WHO/UNICEF JMP	Total, Urban & Rural
b	Population connected to the sewage network	%	WHO/UNICEF JMP	Total, Urban & Rural
c	Population with no connection to the sewage network	%	WHO/UNICEF JMP	Total, Urban & Rural
8	**Data on the occurrence of water related illness and mortality and their causes (sanitation, hygiene, water scarcity etc)**	/	/	/
a	Diarrheal mortality rate (children u5 yrs)	% of CMR	WHO	
b	2 wk prev - diarrhoea	%	DHS, MICS, other surveys	
c	Diarrheal disease rate (children u5 yrs)		DHS/MICS	
d	Diarrheal disease rate (population 5+ yrs)			
e	Other infectious disease mortality (children u5 yrs)		WHO	
f	Other water-sanitation-hygiene related disease incidence			
9	**Waste water charges, if any:**	**/**	**/**	**/**
a	Average rate of domestic charges	€		
b	Average rate of industry charges	€		
c	Total revenues from waste water charges	€		
	PARAMETER: Level of waste water treatment			
10	**Waste water: produced volume**	10^9 m^3/yr	FAO	
11	**Number of people connected to waste water treatment plants**	#		Similar to sewage connection, but distinguish between treatment if possible (primary, secondary, tertiary)
12	**Waste water: treated volume**	10^9 m^3/yr	FAO	
13	**Waste water receiving treatment**	Million m^3, %		Distinguish between type of treatment (primary, secondary, tertiary)
14	**Installed capacities of water treatment plants (population equivalents)**	Million m^3, %		Distinguish between type of treatment if possible (primary, secondary, tertiary)
15	**Waste water released in rivers, lake and sea**	Million m^3, %		Distinguish between type of treatment if possible
16	**Data on sewage loading (if available)**	**/**	**/**	**/**
a	amount of N-tot and P-tot in raw sewage per capita per day			
b	discharge of N-tot and P-tot by waste water treatments plants			
c	discharge from households not connected (in towns with > 2,000 inhabitant equivalents)			
17	**Waste water charges (if existing)**	**/**	**/**	**/**
a	Average rate of domestic charging	€		
b	Average rate for industry discharges	€		

	WATER	Unit	Source	Comments
c	Total revenues from waste water charges	€		
18	**Population living in settlements with > 2,000 inhabitants**	#		
	SUB-THEME: Water - Natural Assets			
	PARAMETER: Surface water quality			
19	**Number of designated bathing waters, Both coastal and inland (rivers, lakes) waters**	#		
20	**Quality of bathing water in designated bathing areas (national classification if existing, or qualitative judgement)**	-		Only general current status and trends (opportunities and threats)
21	**Number of bathers in key areas**	#		Refers to the main areas for which data on bathing water is available – e.g. important rivers/ lakes or coastal areas where bathing is important
22	**Evidence of negative health impacts from bathing waters**	-		Note no. of people affected
23	**Length of the coastline**	km		
24	**Data on tourism/recreation in coastal areas**	-		Number of visitors, general insights on economic importance
25	**Number of rivers**	#		Distinguish between perennial and non-perennial rivers; note how many are shared with other countries
26	**Total river length**	km		Only within the country –note river length delimiting country borders
27	**Quality of the rivers & estuaries (national classification if existing, or qualitative judgement as outlined in the benefits assessment manual- e.g., km^2 or % polluted)**	Km^2 (hectares of catchment area) and %		If only qualitative judgement possible, may use the presence of key biological species as indicator of good/poor water quality, or use info on levels of pollution in main rivers. Note transboundary issues
a	Number, surface area and % of unpolluted rivers at national and regional level. Please check the benefits assessment manual for reference	% or km^2 (hectares of surface catchment area)		
28	**Number of lakes**	#		List the 2-3 most important lakes (in terms of size or economic/environmental importance) Note those which are shared with other countries
29	**Quality of the lakes (national classification if existing, or qualitative judgement** as outlined in the benefits assessment manual- e.g. km^2 or % polluted**)**	km^2 (hectares of surface area) or %		If only qualitative judgement possible, may use the presence of key biological species as indicator of good/poor water quality, or use info on levels of pollution in main lakes. Note transboundary issues
a	Number, surface area and % of unpolluted lakes at national and regional level. Please check the benefits assessment manual for reference	% or km^2 (hectares of surface area)		At national and regional level if possible

	WATER	Unit	Source	Comments
30	**Number of fishermen**	/	/	/
a	Non-professional freshwater fishermen/ number of recreational fishing licences for rivers and lakes	#		
b	Professional freshwater fishermen/ number of professional fishing licences for rivers and lakes	#		
c	Non-professional coastal fishermen/ number of coastal recreational fishing licences	#		
d	Professional coastal fishermen/ number of coastal professional fishing licences	#		
31	**Pesticide consumption**			Indicator of pollution threat – only if an issue and if data is easily available
32	**Insights on negative environmental effects of water quality (e.g.,eutrophication)**	-		Qualitative insights, if possible info on size of area affected
33	**Survey results on attitudes towards pollution control**	-		E.g. % of the population who want to see improvements in water/environmental quality
	PARAMETER: Water resource use			
34	**Water resources available**	/	/	/
a	Surface water: total renewable (actual)	10^9 m^3/yr	FAO	
b	Groundwater: total renewable (actual)	10^9 m^3/yr	FAO	
c	Water resources: total renewable (actual)	10^9 m^3/yr	FAO	
d	Water resources: total renewable per capita (actual)	m^3/inhab/yr	FAO	
e	Dependency ratio	%	FAO	
f	Water resources: total exploitable	10^9 m^3/yr	FAO	
35	**Water withdrawal**	/	/	/
a	Agricultural water withdrawal	10^9 m^3/yr	FAO	
b	Municipal water withdrawal	10^9 m^3/yr	FAO	
c	Industrial water withdrawal	10^9 m^3/yr	FAO	
d	Total water withdrawal (sum of sectors)	10^9 m^3/yr	FAO	
e	Agricultural water withdrawal	% of total water withdrawal	FAO	
f	Municipal water withdrawal	% of total water withdrawal	FAO	
g	Industrial water withdrawal	% of total water withdrawal	FAO	

	WATER	Unit	Source	Comments
h	Surface water withdrawal	10^9 m^3/yr	FAO	
i	Groundwater withdrawal	10^9 m^3/yr	FAO	
j	Total freshwater withdrawal (surface water + groundwater)	10^9 m^3/yr	FAO	
k	Desalinated water produced	10^9 m^3/yr	FAO	
l	Treated waste water reused	10^9 m^3/yr	FAO	
m	Total actual renewable freshwater resources withdrawn	%	FAO	
n	Total actual renewable water resources withdrawn by agriculture	%	FAO	
36	**Index of water stress**[60]	-	UNESCO	Possible sources: http://www.unesco.org/water/wwap/wwdr/indicators/pdf/A3_Relative_water_stress_index.pdf; www.unesco.org/water/wwap/wwdr2/pdf/wwdr2_ch_4.pdf
37	**Sustainable groundwater yield**			Only if data easily available at country level
38	**Extent of water re-use and desalination, etc.**	#		
39	**Other key water requirements e.g. for natural habitats, fisheries and navigation**			
40	**Key problems in the country relating to water resources**	#		E.g. constraints and impacts on agriculture, industry, households and wetland habitats (e.g. rivers, wetlands running dry).
41	**Extent that freshwater flooding is a problem**	-		if available include at risk map
42	**Existing degree of integrated water resource management and water use charging**	-		Include possible evidence (i.e. What are signs of loss of eco-systems)
43	**Projected demand from industry, agriculture and municipality/household use in 2020 – or annual change in output for industry and agriculture**			e.g. World Bank country strategy data
44	**Predicted changes in water availability e.g., due to climate change, re-use, desalination**	-		IPCC downscaling models

60 Water security: ≥ 1,700 m^3 per capita per year of renewable water; Water stress: ≥ 1,000 and < 1,700 m^3 per capita per year of renewable water; Water scarcity: ≥ 500 and < 1,000 m^3 per capita per year of renewable water; Water absolute scarcity: < 500 m^3 per capita per year of renewable water.

D. WASTE

	WASTE	Unit	Source	Comments
1	**General issues re. waste**	-		Qualitative overview of key issues – including issues related to hazardous waste (not covered in this study, but important to know if this is a problem in the country), problems with unmanaged/poorly managed landfills, recycling initiatives etc.
2	**Environmental and health impacts/risks related to waste**	-		Descriptive overview- are there significant health problems (e.g. from methane emissions, leachate, rodents, etc. on landfills, from dioxins from incineration etc. from hazardous waste in non appropriate disposal or recycling operations etc.)
	SUB-THEME: Waste collection			
	PARAMETER: Waste collection coverage			
3	**Total waste generated – total and per capita**	(kg/inhabitant /year)		Total, Urban & Rural
4	**Municipal waste generated per capita**	(kg/inhabitant /year)		Total, Urban & Rural
5	**Type of treatment for municipal waste**	% and t/year		
6	**Type of treatment for total waste**	% and t/year		Distinguish between: Landfilled (sanitary landfills), Open dumping, Recycled, Incinerated and Composted
7	**Major problems concerning waste collection**	-		Qualitative overview
8	**Waste collection service coverage**	%		Population provided with regular waste collection services
9	**Waste charges, if any**	Average amount/year/ household		
a	Population charged for waste collection	€		
b	Average rate OR total revenues from waste collection charges	€		
	PARAMETER: Waste treatment			
10	**Major problems concerning landfills**	-		Qualitative overview
11	**Total municipal waste landfilled**	t/year		(In both sanitary landfills and open dumpsites)
12	**Number and capacity of sanitary landfills**	# and t/day		i.e. landfills with at least an impermeable bottom liner, leachate capture, daily coverage, fencing and permanent staff
13	**Percentage of legally designated landfills**	%		i.e. permitted, managed by the local authority) landfills that are sanitary landfills
14	**Quantity of waste dumped in open dumpsites**	t/year		If estimates available (or can be assessed centrally based on average generated/cap and total collected)

	WASTE	Unit	Source	Comments
15	**Number of open waste dumpsites and type of waste therein**	#		If not available, description of which kind of settlements (size) use an unmanaged municipal dumpsite and which are associated with a managed landfill
16	**Major problems concerning waste recycling**	-		Descriptive overview e.g. lacking separate collection, market for recycled goods, know-how etc.
17	**Composition of municipal waste: glass, plastics, metals, paper, demolition & construction, biodegradable, other**	% and t/year		Only if data are readily available
18	**Total municipal waste recycled (if possible by type of waste e.g., paper, metal, glass, etc.)**	t/year		
19	**Number and capacity of existing recycling facilities**	# and t/day		If possible distinguish by waste type
20	**Presence of informal recycling economy;**	-		e.g. metal and scrap recycling, glass recycling reusable packaging collection, etc. Description, figures if available
21	**Share of biodegradable waste currently diverted (to incineration or composting)**	% and t/year		
22	**Number and capacity of centralised composting facilities**	# and t/day		
	PARAMETER: Methane emissions			
23	**Methane emissions from landfills (released and captured)**	t/year		

E. NATURE

	NATURE	Unit	Source	Comments
1	**General issues re. Nature**	/		Qualitative overview of key issues
2	**Land data**	/	/	/
a	Land area	thousand ha and %	FAO	
b	Inland water	thousand ha and %	FAO	
c	Agricultural area	thousand ha and %	FAO	
d	Forest area	thousand ha and %	FAO	
e	Other land	thousand ha and %	FAO	
f	Arable land	thousand ha and %	FAO	
g	Permanent crops	thousand ha and %	FAO	
h	Permanent meadows and pastures	thousand ha	FAO	
i	Temporary crops	thousand ha	FAO	
j	Fallow land	thousand ha	FAO	
k	Total area equipped for irrigation	thousand ha	FAO	
l	Agricultural area irrigated	thousand ha	FAO	
m	Irrigated (% of arable and permanent crops)	%	FAO	

	NATURE	Unit	Source	Comments
n	Land under cereal production	thousand ha	World Bank	
o	Livestock production index	(2000 =100	World Bank	
p	Live animals (various)	#	FAO	
q	Cereal yield	Kg/ha	World Bank	
r	Crop production index	(1999-2001=100)	World Bank	
s	Employment in agriculture	% tot empl.	World Bank	
t	Fertilizer consumption	Tons & Kg/ha	World Bank	
	SUB-THEME: State of Biodiversity			
	PARAMETER: Level of biodiversity protection			
3	**Protected areas**	/	/	/
a	Terrestrial areas protected	# and % of terrestrial area	IUCN and UNEP-WCMC; World Bank	Number and size (according to IUCN typology)
b	Marine areas protected	# and % of territorial waters	IUCN and UNEP-WCMC	Number and size (according to IUCN typology)
c	PAs that have completed management plan	%		Add insights on the effectiveness of the plans if available
4	**Species**	/	/	/
a	Plant species (higher), threatened	#	World Bank	
b	Mammal species, threatened	#	World Bank	
c	Bird species, threatened	#	World Bank	
d	Fish species, threatened	#	World Bank	
e	Number of species identified nationally as rare/endemic/nationally important	#		
5	**Number and area of IBAs (by category) & proportion protected**.	# % ha	Birdlife	Provided insights on adequacy and coherence
6	**Employment and revenue from nature conservation**	/	/	/
a	People employed in nature conservation activities (in full time equivalents)	FTE in any one year		If possible breakdown into national park / protected area staff, government conservation staff, other conservation staff
b	Number of tourists per year in protected areas/natural parks	# / year		
c	Revenue from visitors / tourism to nature conservation sites and/or average entrance fee; other revenues	€ / year		
7	**National targets for protected areas coverage**			if possible distinguish between terrestrial and marine
	SUB-THEME: Sustainable use of natural resources			
	PARAMETER: Level of deforestation			
8	**Total area and (if possible) distribution of forest and other wooded land in the country**	#, ha	e.g., from http://rainforests.mongabay.com/deforestation/	
9	**Designated functions of forest**	%		production, protection, conservation, social services, etc.
10	**Forest characteristic**	-		primary, modified natural,

	NATURE	Unit	Source	Comments
				semi-natural, productive plantation, protective plantation
11	**Annual change rate of characteristics of forest area**	%, ha	e.g., from http://rainforests.mongabay.com/deforestation/	
12	**Current deforestation rate**	ha / yr		Distinguish between human-made and climate-induced (e.g., forest fire arising from increase incidence of drought)
13	**Drivers of deforestation and their trends**	-		Qualitative description
	PARAMETER: Land degradation in relation to arable land			
14	**Level of land degradation**	/	/	/
a	Area affected by land degradation (mild, moderate, severe, very severe degradation)	% and 1,000 km²	FAO (GLASOD data)	% of national territory (% of arable land if available)
b	Area effected by soil salinity and at risk of erosion	% and 1,000 km²	FAO (GLASOD data)	% of national territory (% of arable land if available)
c	Area affected by other forms of degradation			% of national territory (% of arable land if available) (e.g. soil acidification, soil alkalinisation, destruction of soil structure including loss of organic matter – other country specific problems)
d	Area at risk of desertification	% and ha		
15	**Drivers of and trends in soil erosion**	-		
16	**Drivers and trends in land degradation**			Arable land
17	**Agricultural crop cultivation**	/	/	/
a	Yields of crops cultivated	hg/ha	FAO	National average yields for each crop cultivated
b	Area cultivated by crops	ha	FAO	Area for each crop
c	Crop yield reduction effects of land degradation			Ideally by land degradation classifications in (a), i.e., mild, moderate, severe, and very severe degradation
d	World prices of cereals	€/ton	Commodity price reports	
e	Domestic producer prices of vegetables/fruits and other non-cereals	LCU/ton	FAO	
	PARAMETER: Rangeland degradation			
18	**Rangeland degradation**	/	/	/
a	Total area of rangeland	ha		Land used for livestock grazing
b	Area of degraded rangeland	ha of %		
c	Drivers and trends in rangeland degradation	-		Qualitative description
d	Drivers of demand for rangeland production	-		
19	**Fodder yields in rangeland**	/	/	/
a	Pasture/rangeland fodder yields	Tons of DM/ha		Original (before degradation) and current yields
b	Price of livestock fodder	LCU/ton of DM		DM=dry matter
c	World price of barley			

	NATURE	Unit	Source	Comments
d	Livestock holdings (cattle, sheep, goats)	#	FAO	

F. CLIMATE CHANGE

	CLIMATE CHANGE	Unit	Source	Comments
	PARAMETER: deforestation	/	/	**Covered under Nature**
	PARAMETER: Methane capture from landfill	/	/	**Covered under Waste**
	PARAMETER: Uptake of renewable sources of energy (RES)			
1	**Key issue related to RES**	-		Qualitative overview and future potential
2	**Insights on energy and emission trends**	-		e.g. from 1990 to date; future trends if available
3	**Energy gross final consumption (total and by source)**	ktoe	EIA	Cross check with national data
4	**CO_2 emissions by source**	Kt	EIA	Cross check with national data
	PARAMETER: Climate change adaptation			
6	**Information on impacts**	/	/	/
a	Seal level rise	-		
b	Sea temperature rise	-		
c	Desertification	-		
d	Changes in water availability/drought	-		Also covered under water scarcity – cross refer in text
e	Increased risk of pest or disease outbreaks	-		
f	Risk of forest fires	-		
g	Risk of flood	-		Also covered under water scarcity
h	Data on extreme weather events	# people affected, € damage		Events include drought, flood, severe storms etc
i	Other adaptation measures (to 2 ° Celsius) (current/planned/potential)			If relevant

ANNEX VII – EXCEL WORKSHEET

An excel worksheet has been prepared to support the calculation of the benefits for the following parameters:

- waste water treatment
- water scarcity
- waste
- forestry
- RES

The excel sheet can be downloaded from the project's website:

http://environment-benefits.eu/index.php?mid=5&smid=1&cid=0