D2.1 Research Note: Evaluation of Indicators for EU Policy Objectives

Tanja Srebotnjak
Holger Gerdes
Aaron Best
Sandra Cavalieri

27 November 2009

Corresponding author:
Aaron Best
Ecologic Institute
Tel: +49(0)30-86880-140
e-Mail: aaron.best@ecologic.eu

Ecologic Institute, Berlin
www.ecologic.eu

Table of Contents

List of Figures

List of Tables

List of Boxes

List of Acronyms

ANS	Adjusted Net Savings
APR	Annual Progress Report
CEC	Commission of the European Communities
CIP	Competitiveness and Innovation Framework Programme
CO_2	Carbon dioxide
eaNNP	Environmentally adjusted Net National Product
EDP	Excessive deficit procedure
EEA	European Environment Agency
EESC	European Economic and Social Committee
EMU	Economic and Monetary Union
ERM	Exchange Rate Mechanism
Eurostat	Statistical Office of the European Community
EU	European Union
GDP	Gross Domestic Product
GNI	Gross National Income
GNS	Gross National Savings
GS	Genuine Savings
ISEW	Index of Sustainable Economic Welfare
JTI	Joint Technology Initiatives
MTO	Medium-term Budgetary Objective
NAMEA	National Accounting Matrix with Environmental Accounts
NNP	Net National Product

NNS	Net National Savings
NRP	National Reform Program
ODA	Official development assistance
OECD	Organisation for Economic Co-operation and Development
PM	Particulate matter
PPS	Purchasing Power Standards
R&D	Research and Development
SD	Sustainable Development
SDI	Sustainable Development Indicators
SDS	Sustainable Development Strategy
SEEA	System of Integrated Environmental and Economic Accounting
SGP	Stability and Growth Pact
SNA	System of National Accounts
TEC	Treaty Establishing the European Community
TEU	Treaty on European Union (Maastricht Treaty)
UN	United Nations
UNCED	United Nations Conference on Environment and Development 1992, Rio de Janeiro, Brazil
UNDSD	United Nations Division for Sustainable Development
UNSD	United Nations Statistics Division

Executive Summary

The purpose of this document is to present three pilot qualitative evaluations of the following accounting systems and indicators: Gross domestic product (GDP), the Adjusted Net Savings (ANS) indicator, and the System of Integrated Environmental and Economic Accounting (SEEA-2003). While the focus of the pilot phase was on accounting approaches, subsequent evaluations will cover the full spectrum of economic and sustainable development indicators. A main objective of the pilot phase was to develop and test the qualitative evaluation methodology.

Regarding the evaluation of GDP, the most recent assessment is the one published by the Stiglitz Commission in September 2009. The authors of this Research Note concur with the GDP assessment of the Stiglitz Commission and given the assessment's comprehensive nature, the IN-STREAM project refrains from repeating this particular assessment in detail.

Background

The EU is committed to enhancing the economic prospects and human well-being of Europe's people. Through the Lisbon Strategy, agreed by the Lisbon European Council in March 2000, EU policymakers aim to increase the international competitiveness of the European economy and expand employment opportunities. In 2001, the EU Sustainable Development Strategy (SDS) was developed as a complement to the Lisbon Strategy. While the Lisbon Strategy aims to increase competitiveness and employment within the EU by identifying goals and objectives to improve Member State economies, the Sustainable Development Strategy adds to the Lisbon Strategy a range of environmental and social goals.

In 2006, the Lisbon Strategy and the SDS were separately revised and renewed. Both revisions promote enhanced communication among local, national and EU levels of government to achieve stated objectives and create mechanisms for frequent evaluation. The revised Lisbon Strategy aims to streamline the co-operation between the Commission and the Member States and focuses on two primary targets for 2010: 1) invest 3% of Europe's gross domestic product (GDP) in research and development, and 2) reach an employment rate of 70%. Similarly, the revised SDS sets enhanced objectives and action items for seven key priority areas and proposes ways to improve government co-ordination. A key contribution is the clarification of its synergies with the Lisbon Strategy. The revised SDS is to be reviewed every two years to monitor progress towards its goals.

The global financial and ensuing economic recession that began in late 2007 largely reversed the progress made in the EU towards reaching the Lisbon Strategy objectives. On the other hand, the 2009 review of the SDS highlights the opportunity presented by the global financial crisis to include incentives in economic stimulus and recovery packages and to promote regulatory changes with a view toward shifting to a low-carbon economy. It emphasizes the synergies with the Commission's Recovery Plan from November 2008, and focuses on green growth as a goal for both the SDS and the Lisbon Strategy.

The Need for Indicators

The goals, targets, and criteria enshrined in the Lisbon and SD strategies as well as the Maastricht Treaty highlight the need for indicators that go beyond conventional measures the performance, structure and growth of the market economy. Though mainstream economic measures such as GDP are useful measures with great influence on public and private decisions, they are flawed as measures of human welfare. This view is echoed by Eurostat, whose monitoring report states that indicators of sustainable development are still needed and that possibilities of developing a SD scoreboard are explored by the European Commission. The Commission's Communication 'GDP and beyond, Measuring progress in a changing world' (August 2009) and the Stiglitz Commission's final report (September 2009) both send a strong message regarding the need to complement GDP with environmental and social indicators.

The Commission's Communication states that GDP is still the best indicator to measure the performance of a nation's economy, but is not enough to capture all important aspects of peoples' lives. The Communication echoes the 2009 review of the SDS in calling for a rapid transition to a low-carbon economy, and states that sustainability indicators 'could contribute to setting new strategic goals for the post-2010 Lisbon Strategy'.

The IN-STREAM Project – Pilot Qualitative Analyses of Key Indicators

At this stage of IN-STREAM, a specific qualitative methodology was developed to analyse a number of key indicators selected for inclusion in the project. This report summarises three pilot qualitative evaluations: Gross domestic product (GDP), the Adjusted Net Savings (ANS) indicator, and the System of Integrated Environmental and Economic Accounting (SEEA-2003). Through the evaluations, the qualitative evaluation methodology used in IN-STREAM

was developed and revised. The updated methodology will be used on the remaining indicators evaluated in the project.

The report contributes to IN-STREAM by providing a qualitative analysis of highly policy relevant indicators where quantitative methods used elsewhere in the project are limited in their evaluative potential. For more on the IN-STREAM project overall, see http://www.in-stream.eu.

Evaluation of Indicators to Complement Mainstream Economic Indicators

This research note presents the progress made on the qualitative evaluations in objective 1 and 2 of IN-STREAM, namely the evaluation of key indicators and indicator efforts, and the evaluation of institutional needs and opportunities. In order to evaluate the capacity of indicators to complement and expand the message sent by mainstream macro-economic indicators, most of all GDP, three existing approaches for selecting and evaluating indicators – RACER, SWOT, and the European Commission's SDI criteria for indicator selection – were combined and expanded. With the resulting evaluation template it was possible to systematically characterize the indicator's policy linkages and methodological foundations and still leave sufficient flexibility to consider each indicator's particularities and specific features. Detailed information on the methodologies used can be found in Section 0.7 of the executive summary.

The evaluation framework was applied to two indicators and one framework: GDP, the Adjusted Net Savings (ANS) indicator, and the System of Integrated Environmental and Economic Accounting (SEEA-2003). These indicators and the SEEA were chosen because they all represent accounting-based approaches to assessing economic performance, economy-environment interactions, or sustainability. The SEEA is evaluated as a framework without singling out specific indicators that can be calculated from it, because it has gained considerable traction and evolved into a de-facto international standard for environmental accounting principles and frameworks, which the expected elevation to an international statistical standard will only cement. The SEEA furthermore suggests a small number of specific sustainability indicators in Chapter 11, which if evaluated individually would lead to a substantial duplication due to their largely shared methodology. While the 'single indicator analyses' provide detail on the methodological basis, their strengths and weaknesses, the 'basket analysis' seeks to identify the added information or potential pitfalls in interpretation that arise when the selected indicators are combined.

Results

Single Indicator Analysis: GDP

GDP is a measure of aggregate economic activity within the national accounting systems. It measures, in monetary terms, income and output for a country's or region's economy. It is defined as the total market value of all final goods and services produced within a country or region in a given period of time (OECD, 2002). GDP can measure economic activity in three ways:

Consumption goods and services
+ Gross investments
+ Government purchases
+ (Exports – Imports)

or

Employee compensation
+ Corporate profits
+ Proprietor's income
+ Rental income
+ Net interest

or

Value of sales of goods

GDP has its roots in the aftermath of the Great Depression (1929 – mid 1930s) and quickly became the main indicator for a nation's economic performance. It is often used and cited as a proxy measure for human wellbeing although it is widely known and also acknowledged by its developers that it has significant shortcomings as a welfare measure and being a measure of aggregate economic production, does not capture all aspects of economic activity (e.g. income and consumption). The main limitations include:

- GDP does not include non-market transactions, such as voluntary, unpaid services, nor the 'black economy'.
- GDP does not account for depletion of natural capital or ecosystem quality. In contrast, GDP increases if natural resources are (over-) depleted.
- GDP considers investment in capital but ignores the depreciation of capital. Depreciation is usually relatively constant when the structure of production stays the same – in this case capital depreciation would be a relatively constant deduction from

GDP. However, this is not the case as countries shift from agricultural to industrial and service-oriented economies and are becoming increasingly technology-based. This shift in the structure of production means that depreciation of capital has concomitantly changed. Moreover, it ignores depletion of natural capital or ecosystem quality.

- GDP does not account for changes in the value of human capital.
- GDP considers only income flows, not stocks, while standard of living considerations should include stocks of wealth.
- GDP gives no indication of the distribution of wealth, especially when quoted as per capita GDP. It caters to the statistical mean and does not capture the spectrum of experience from wealthy to poor in a particular country.
- GDP per capita measures do not account for household size and does not incorporate household services, which could equate to 30-40% of GDP.

The recommendations of the Stiglitz Commission regarding GDP are listed in Box 1. Despite its shortcomings as an indicator of human wellbeing or sustainability, the long history of its development and ubiquitous use in economic reporting mean that the data and methodological bases are generally well developed worldwide, it is calculated frequently with reliable and robust quality, and is generally seen as the most important structural indicator. GDP is therefore not likely to disappear from national balance sheets any time soon.

Box 1 Recommendations of the Stiglitz Commission with regard to GDP

The "Commission on the measurement of economic performance and social progress" (Stiglitz Commission) has been set up in 2008 on the initiative of French President Nicolas Sarkozy in order to reflect the concerns related GDP figures as measures of societal well-being as well as of economic, environmental, and social sustainability. In September 2009, the Stiglitz Commission published its final report (Stiglitz, Sen and Fioussi, 2009a) with an updated critique on GDP. The main recommendations with regard to necessary improvements are listed below:

Recommendation 1: Look at income and consumption rather than production.

Recommendation 2: Consider income and consumption jointly with wealth.

Recommendation 3: Emphasise the household perspective.

Recommendation 4: Give more prominence to the distribution of income, consumption and wealth.

Recommendation 5: Broaden income measures to non-market activities.

Single Indicator Analysis: SEEA-2003

The SEEA has its roots in the System of National Accounts (SNA). In developing the SNA, the United Nations (UN) and collaborating agencies established a standard method for keeping track of economic activity and growth but failed to include the environment and natural resource depletion as major aspects of this accounting system. In 1993, the United Nations Statistics Division (UNSD) developed the first (interim) international handbook for environmental accounting. This publication, entitled the Handbook of National Accounting: Integrated Environmental and Economic Accounting is known as SEEA-1993. By 2000, the SEEA-1993 had become the leading approach to environmental accounting, used in several developed and a few developing countries. A revision was commissioned by the UN Statistical Commission, which was finalized in 2003 and is known as the SEEA-2003. In 2005 the UN Statistical Commission requested the 2nd revision of the SEEA by 2010 to be elevated to an International Statistical Standard. The UNCEEA (UN Committee on Environmental-Economic Environmental Accounting) was tasked with the revision with the cooperation of the London Group and other key players in environmental accounting.

Thus, the SEEA-2003 is not a single indicator but an international coherent and comprehensive accounting framework for measuring objectively and consistently how environmental functions contribute to the economy and how the economy exerts pressures on the environment. It is possible to derive indicators of mostly weak sustainability from the SEEA, e.g., environmentally adjusted Net National Product (eaNNP), Genuine Savings (GS, aka ANS), and Index of Sustainable Economic Welfare (ISEW).

The SEEA-2003 has the following key limitations:

- The valuation of environmental resources, depletion, and degradation depends on normative values, discount rates chosen, and methods to determine prices (e.g., willingness to pay, shadow prices, etc.).
- The SEEA-2003 does not endorse or provide clear guidance on valuation, accounting, and modelling techniques necessary to put monetary values on environmental resources and services.
- The SEEA-2003 makes references to sustainable development but remains vague on its operational definition and does not promote actual sustainability indicators. SEEA-2003 suggests indicators ‘warning of threats to sustainability’ but does not measure sustainability.

- The SEEA-2003 vaguely favors a 'capital maintenance' approach to sustainability which it then links to a micro-economic Hicksian income concept. Bartelmus (2007) points out that Hicks and national accountants have shown that micro-economic Hicksian income "… cannot be aggregated and is incompatible with the 'net worth' definition of wealth in the national accounts."
- The aggregation of items based on mass units as opposed to monetary units is also controversial because of their different environmental impacts (e.g., a ton of wood wastes from a timber mill does not have the same environmental impacts as a ton of mining wastes).
- The SEEA-2003 is very data intensive, although the modular set-up means that the entire SEEA does not need to be implemented.
- The SEEA-2003 does not capture other sustainability concepts such as 'resilience' or 'vulnerability', nor does it represent the emerging field of accounting for ecosystems.

In summary, the SEEA-2003 does not provide indicators for whether a country's economic activity is sustainable or not (and may therefore not realize its full potential), but is a comprehensive accounting system for tracking environmental and economic capital, rents, and expenditures. The revised SEEA (2010) can bring consistency, coherence, and wider cross-applications to environmental accounting. The accounting system does not engage in debates over environmental accounting, and therefore does not give the end user much guidance in determining whether a country is either weakly or strongly sustainable. A growing number of countries, primarily those in the OECD and countries endowed with environmental resources use the SEEA to compile environmental accounts in varied format and completeness.

Its ties to the SNA and therefore to GDP – but also to ANS – make it a useful framework for bridging traditional macro-economic performance and protection and preservation of environmental resources and life support services. The ongoing development of the SEEA and its expected elevation to an international statistical standard give hope to the more widespread and harmonized implementation of environmental accounts, which could ultimately lead to the availability of comparable national and globally aggregated indicators of environmental sustainability.

Single Indicator Analysis: ANS

ANS (previously known as Genuine Savings indicator) measures the true rate of savings in an economy after taking into account investments in human capital, depletion of natural

resources and damage caused by pollution. The ANS aims to be a measure of the sustainability of investment policies by measuring changes in wealth during a specified accounting period. In particular, it allows to test whether rents from natural resources and changes human capital are balanced by net saving in man-made capital. ANS expands the notion of 'assets' by including natural resources and human capital. It's importance from economic and sustainability perspectives is summarized by Hamilton (2000) in the theoretical motivation for ANS (GS): „Given the centrality of savings and investment in economic theory, it is perhaps surprising that the effects of depleting natural resources and the environment have not, until recently, been considered in the measurement of national saving." The basic equation for ANS is:

Gross national savings (GNS)
– Consumption fixed capital

=

Net national savings (NNS)
+ Education expenditure
– Mineral depletion
– Net forest depletion
– Damages from CO_2 emissions
– Damages from PM emissions

Usually, ANS is expressed in percent of Gross National Income (GNI) and positive ANS is indicative of a non-declining capital base while negative ANS over several accounting periods points to unsustainable production. However, these interpretations have to be taken with caution because despite the improvement over GDP in accounting for depreciation and depletion of fixed and environmental capital, ANS is plagued by a number of limitations, including

- The underlying concept of sustainability is weak sustainability (i.e. allowing for virtually unlimited substitutability between natural capital and and-made capital).
- The addition of education expenditures to savings assumes that $1 in expenditures equals $1 in human capital.
- Private education expenditure is not included in ANS.
- There is no exhaustive accounting of natural resource depletion and degradation (missing are, for example, water resources, fisheries, soils, and biodiversity).
- The accounting of net forest depletion includes only timber but not non-timber benefits provided by standing forests (e.g., soil protection, mineral cycling, biodiversity).

- The accounting of natural resource depletion and degradation suffers from same problems of other accounting-based sustainability indicators, incl. calculation of resource rents as difference between market value of extracted resource and average extraction cost instead of marginal cost.
- Missing data on prices, extraction costs, amounts of resources extracted, education expenditures, etc. require imputation and hence frequently untestable assumptions.
- Population growth not factored into the relationship that current changes in ANS equate to net present value of changes in future consumption.
- ANS does not reflect technological changes.
- ANS does not address the problem of how to treat trans-boundary damages.

Since the World Bank adopted the ANS indicator in 1999, its geographical coverage has steadily increased and now covers more than 130 economies annually. Still, the limitations in data availability and quality still hamper the calculation of this indicator, but it is gaining traction among policymakers, environmental economists, and other users because of its ties to the established economic accounting system, possibilities to include additional components (should data collection and methods development advance further), and its empirically supported ability to identify economic patterns that are not sustainable, primarily in resource rich developing countries ('resource curse').

Basket Analysis: GDP, ANS and SEEA-2003

GDP, ANS, and SEEA together measure (1) the total market value of all goods and services produced in the market sphere in an economy during the accounting period, (2) the monetary savings rate taking depletion and degradation of selected environmental capital as well as an estimate of the investment into human capital into account, and (3) offer a framework for a host of further indicators of economic-environmental relationships (and sustainability). Thus, as a basket the three tools support and enhance each other and have demonstrated policy relevance for characterizing the degree to which an economy is on a sustainable path with respect to its use of environmental goods and services.

Although the basket of GDP, ANS, and SEEA allows for a more nuanced depiction of economic performance and its relationships to the environment, none of the three indicators/frameworks individually and as a group measure true sustainability with respect to either a strong or weak sustainability criterion. However, especially the SEEA and the ANS could be expanded to cover a maximum of natural resources and their depletion or degradation. Trends in the individual measures might go into opposite directions, e.g.,

positive GDP but negative ANS, which does not pose a contradiction but an opportunity for a more fine-grained and truthful sustainability analysis. At the same time, the basket of GDP, ANS, and SEEA cannot set an unequivocal sustainability value or threshold. It also does not warn of reaching critical tipping points or thresholds with no reversibility.

The GDP, ANS, and SEEA complement each other in several ways: GDP measures economic performance, which is supplemented by a environmentally and socially adjusted savings (i.e., a forward-looking capital maintenance measure) and further supported by information on the stock and flows (perhaps also value) of environmental assets, the pollution generated by economic activity, and the resulting damages to future environmental resource streams. GDP, ANS, and SEEA are all linked and to a high degree integrated via the System of National Accounts.

The complementary powers of GDP, ANS and SEEA and how much they capture of the economic, environmental and social spheres is shown in a schematic depiction in Figure 1.

Figure 1 Schematic representation of the coverage and overlap between GDP, ANS, and the SEEA-2003

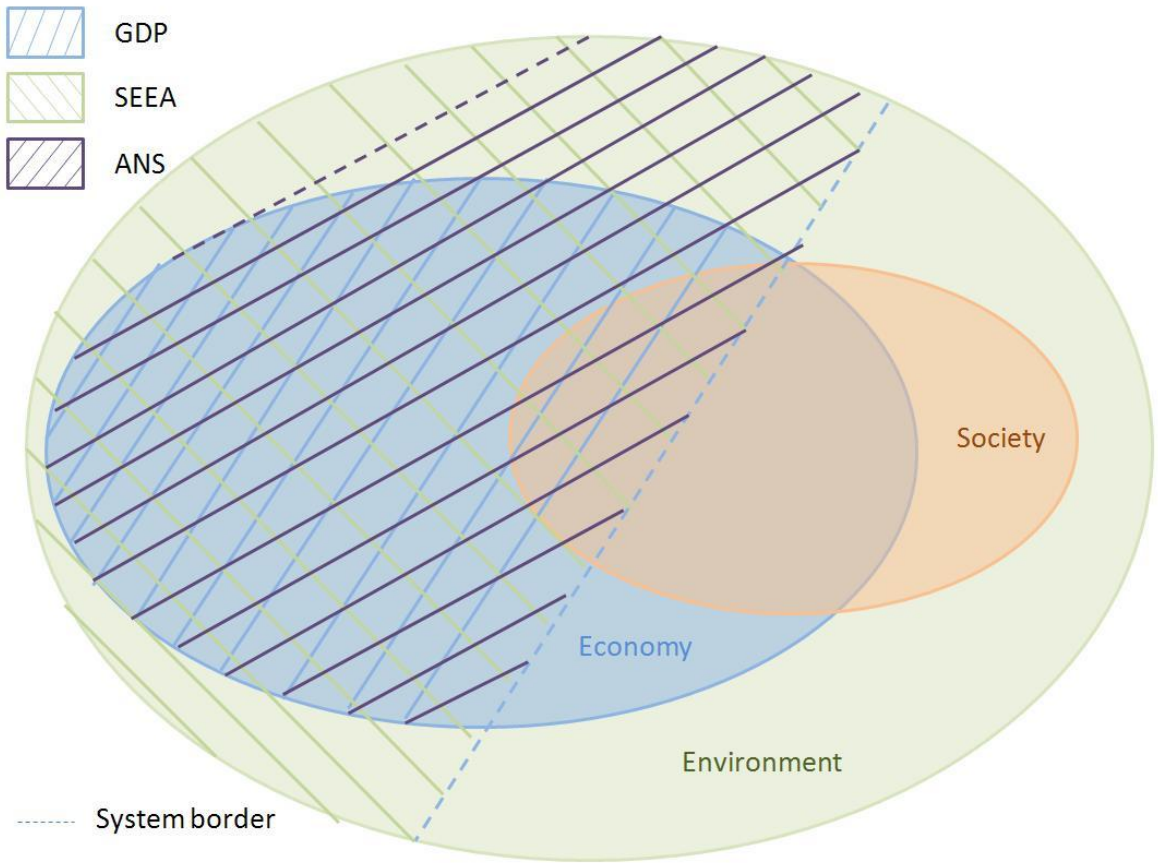


Table 1 summarizes the individual strengths and weaknesses of each indicator and the SEEA-2003 and thereby also visualizes where they complement each other and how synergies are created that enhance the value of the individual measure and makes the basket useful to bridge the traditional dominance of macro-economic indicators.

Criterion	GDP	ANS	SEEA-2003
Policy relevance for IN-STREAM	High	High	High
Used to measure sustainability	No	Yes	Yes
Definition of sustainability	None	Weak	Weak (strong possible)
Link to sustainable development	Yes, via economic development	Yes, by adjusting GDP for depreciation and degradation of environmental capital and investment in human capital	Yes, by expanding boundary of economic system to include environmental assets and services
Level of methodological development	High	High with possibility to include additional environmental assets and forms of human capital and their valuation	High with possibility to further develop valuation methods and additional satellite accounts
Defensible theory	Yes	Yes	Yes
Level of adoption of the indicator by targeted users	High	Reported by World Bank and limited uptake by countries and researchers	Limited and incomplete uptake primarily by OECD and resource-rich countries
Driving forces of institutional adoption	Main indicator of economic performance since 1930s	Controversial methods to value resource rents and investments in human capital, high extent of missing data, lack of monetary values for	Substantial investment in resources (people, knowledge, data), conceptual disagreements on methodology on how to measure

		environmental goods and services, hesitation of national accountants and statisticians to 'water down' stringent rules and theoretically sound assumptions for calculating GDP	sustainability, lack of emphasis on how and which sustainability indicators to calculate
Links to international and EU law, conventions and agreements	Lisbon Strategy, Maastricht Treaty, ODA goals	EU SD Strategy, Lisbon Strategy, Johannesburg Plan of Implementation	1992 Rio Summit, Link to SNA and NAMEA, potential to become international statistical standard in 2010
Data availability (in EU)	Complete	Incomplete	Incomplete
Data quality (in EU)	High	Good to satisfactory	Good to satisfactory
Accuracy	High	Satisfactory	Good to satisfactory
Trends and forecasting	Yes	Yes	Yes
Geographical scale of application	Sub-national to global	National at present	Mostly national but sub-national has been done
Sensitivity	High	Good	High
Reliability	High	Good	High to good
Completeness	High to good	Satisfactory	Good to satisfactory
Transparency	High	High	High

Table 1 Summary and side-by-side comparison of single indicator evaluation.

Methodological Challenges

Indicator evaluation faces several well-known challenges. In most instances one would like to obtain an order of the indicators in the set that 'grades' them according to the purpose of the evaluation from best to worst. Usually it is not possible to obtain such continuous or even just

ordinal ordering in an objective way because the characteristics one wishes to evaluate are themselves not numerical or fully measurable. Examples for numerical characteristics are smallest variance, bias and frequency of calculation, while not measurable features include policy relevance, data quality and complementarity. The evaluation can still be done in terms of a qualitative and descriptive analysis but the set of evaluation criteria cannot be brought into a meaningful numerical score. The IN-STREAM template therefore contains a broad set of open-ended questions that are applicable to all indicators in the set but leave room to describe indicator-specific details in a more nuanced way. Positive and negative aspects of an indicator are identified but no summary score is obtained.

A related second impediment is the tension between objective versus subjective evaluation. While evaluation criteria can be selected with a certain level of generalization and through a consultation process that ensures a high degree of acceptance, the actual assessment remains subjective in the sense that different analysts can come to different conclusions. In the IN-STREAM evaluation the initial step consisted of a lead analyst evaluating a set of indicators, which was followed by a group review and discussion and resulted in a revision of the results before a final group discussion concluded an indicator or basket evaluation. This process ensured that (a) individual perspectives and judgments did not color an evaluation, (b) all perspectives and voices in the group were heard and contributed to the evaluation, (c) the final evaluation represents the consensus of the team members.

The third aspect in indicator evaluation concerns the choice of evaluation instrument. IN-STREAM used a combination of three existing tools – RACER, SWOT, and the SDI criteria – and further expanded and harmonized them to yield a tabular evaluation sheet that harnesses the strengths of each approach and provides a comprehensive but manageable assessment tool. However, for the many useful and informative criteria included in the template there are others that are not and that are relevant for different purposes.

Thus, IN-STREAM took considerable efforts to increase objectivity, use qualitative descriptions and avoid the corset of numerical scores, and ensure comprehensiveness. Nonetheless, the present evaluation represents only one possibility out of many to assess the utility of environmental and social indicators to complement the mainstream macro-economic measures of performance and wellbeing. The conclusions and recommendations derived from the analysis, while buttressed by extensive reviews of the theoretical and empirical literature, the expertise of the project team members and several rounds of discussion and consensus finding, must be seen in this context. As more data and empirical

evidence on the selected indicators becomes available and new tools for indicator evaluation are developed, the present qualitative analysis can be extended and improved upon.

Conclusions

The evaluation of the indicators GDP, the Adjusted Net Savings indicator (ANS, also known as Genuine Savings), and the System of integrated Environmental and Economic Accounting 2003 revision (SEEA-2003) individually and as a basket yielded a number of insights that can inform policy-makers in the European Commission and Member States about the linkages, synergies and trade-offs, between the goals of economic growth and competitiveness on the one side and environmental protection, sustainable management of natural resources, and social cohesion and well-being on the other.

First of all, and it is well-known, GDP is not a useful measure of well-being or environmental sustainability and should either be replaced by a more comprehensive measure or – and this is the objective of the IN-STREAM project and the current trend in the EU – be complemented by additional aggregate indicators that capture the environmental and social dimensions.

ANS and the SEEA-2003 framework are both accounting-based measures, albeit the SEEA is a framework and as such offers the calculation of a host of natural resource and environmental indicators. Both expand the conventional boundaries of the economic system to include environmental assets as well as environmental pollution. In addition, ANS includes one element of social capital and that is investment into human capital via public expenditures. Since this is the only item on the social dimension and is a rather crude estimate, it remains questionable to what extent the ANS adds useful value as a social sustainability measure. However, its contributions to capturing elements of natural resource depletion and pollution generation are well founded and a meaningful addition to the conventional macro-economic indicators led by GDP.

The SEEA is the only comprehensive environmental accounting system to date and which has good chances of being elevated to an international statistical standard upon the completion of the revision of the 2003 version in 2010. This would greatly promote its adoption world-wide as the environmental accounting tool of choice and thereby indirectly facilitate the generation of more widely comparable indicators of environmental sustainability.

As complete as the treatment of the various types of environmental accounts in the SEEA-2003 is, the developers acknowledge a number of methodological and systematic shortcomings that arise when one tries to integrate environmental management into an economic accounting system. The valuation of environmental services remains controversial with no consensus in sight. A number of environmental services are intrinsically difficult to measure whether in physical or monetary terms, such as biodiversity and aesthetic values. Therefore, while the SEEA certainly has high potentials to become an information system for governments and international bodies, there is still room for continued improvement as well as other indicators.

The basket analysis revealed that GDP, ANS, and the SEEA form a complementary system of measures that overlap to a certain extent but that each add value by giving a perspective of sustainability of the system that the others do not. GDP based on the System of National Accounts and the SEEA-2003 are the most complementary and complete while ANS adds a single aggregated indicator that – as the World Bank has demonstrated – can be compiled at reasonable cost, defensible assumptions, and on a globally comparable basis. It may thus be more useful in the short to medium term as SEEA adoption progresses and together with the SNA forms the data and methodological basis for national accountants.

About the Evaluation Methodology

Box 2 Evaluation approaches

The RACER criteria for identifying useful indicators were developed as part of the "European Commission's Impact Assessment Guidelines". It is an evaluation framework developed for assessing the value of scientific tools for use in policy making. RACER is an acronym for **R**elevant – **A**ccepted – **C**redible – **E**asy – **R**obust. IN-STREAM has added sub-criteria to RACER aimed at tailoring the methodology to the specific objectives of IN-STREAM. RACER and the sub-criteria have already been successfully applied in the project "Potential of the Ecological Footprint for monitoring environmental impacts from natural resource use" which was carried out for the European Commission's DG Environment.

The Sustainable Development Strategy's commitment to regular monitoring led to the creation of the Sustainable Development Indicator Task Force tasked with the development of the indicators that would allow such monitoring and also inform decision-makers and the general public about achievements, trade-offs, and failures in attaining the agreed upon objectives of the SDS. The SDI Task Force subsequently specified criteria that govern the selection of individual metrics and sets principles, which the collection of selected indicators should follow. They are:

Portfolio principles

- The portfolio of indicators should, as far as possible, be balanced across different dimensions.

- The indicators should be mutually consistent within a theme.
- The portfolio of indicators should be as transparent and accessible as possible to the citizens of the European Union.

The third approach, SWOT, stands for Strengths – Weaknesses – Opportunities – Threats and was originally developed by Stanford University researchers to evaluate business capabilities to achieve stated objectives. The initial method has since been revised multiple times and successfully applied to indicator evaluation.

Box 3 Tabular evaluation template

The three approaches were merged into a tabular evaluation template characterized by mostly open-ended questions and additional sub-criteria. There is one template for single indicator analysis and one for evaluating a basket of indicators. The basket evaluation template follows the same principles but makes logical adjustments to allow for the joint evaluation of the strengths and weaknesses of multiple indicators. The single indicator template is organized into the following sections:

I. **Indicator Summary** with meta-information on the name and category of the indicator.

II. **Background Information** on the indicator including official name, unit of measurement, and history of development.

III. Description of the **Data**, data quality and data collection process.

IV. **Link to Sustainable Development**, including operational definitions of sustainability and quantitative values associated with it.

V. **Institutional Analysis** examining forces and processes leading to or hampering the use of the indicator.

VI. **RACER analysis** as discussed above.

VII. **Supplemental RACER analysis** with special emphasis on policy relevance for selected EU objectives in the context of the EU Sustainable Development Strategy.

VIII. **Potential Links to Other Indicators** to strengthen the indicator's relevance for the EU policy framework set by the Lisbon and SD strategies and the Maastricht treaty.

IX. **SWOT Analysis** as discussed above.

1 Introduction

1.1 Background

The EU is committed to enhancing the economic prospects and human well-being of Europe's people. Through the Lisbon Strategy,[1] EU policy-makers aim to increase the international competitiveness of the European economy and expand employment opportunities. To assist in this, key economic indicators of each Member State are closely watched as a means of assessing the performance, structure and growth of the market economy. Though mainstream economic measures such as GDP are useful measures with great influence on public and private decisions, they are flawed as measures of human welfare (Stiglitz, Sen and Fitoussi, 2009). In addition, they give little information as to whether the market is helping Europe make progress on its environmental goals and its commitment to sustainable development.

There is therefore a critical need in Europe for indicators and measurement systems that – working in conjunction with and complementing mainstream economic indicators – provide a useful measure of progress toward economic success, human well-being, environmental protection and, thereby, long-term sustainability.

Some initiatives have already been taken to address this need. For example, a comprehensive set of indicators has been developed by the Sustainable Development Indicator (SDI) Task Force to assist the EU in achieving the objectives of its renewed Sustainable Development Strategy. This set of 12 headline indicators, 45 core policy indicators and 98 analytical indicators covers ten themes related to the policy priorities of the SDS.[2] And world-wide, since the early 1990s, there has been significant work on indicators and green accounting as a means of providing information not offered by traditional economic indicators. *The Compendium of Sustainable Development Indicator Initiatives* lists over 680 different indicator efforts going on around the world.[3] In recent years, significant progress has been made on sustainability indicators and green accounting measures, as evidenced in the report*, Indicators for Sustainable Development: Proposals for a Way*

[1] See http://ec.europa.eu/growthandjobs/.
[2] The ten SDI themes are: economic development; poverty and social exclusion; aging society; public health; climate change and energy; production and consumption patterns; management of natural resources; transport; good governance; and global partnership.
[3] See http://www.iisd.org/measure/compendium/

Forward (IISD, 2005), prepared by the United Nations Division for Sustainable Development. However, despite the significant work undertaken on indicators, indicator sets and composite indicators, these initiatives have failed to end the hegemony of mainstream economic measures as the dominating indicators of human progress.

Over the years, ambitions regarding indicators seem to have been scaled back, away from an integrated system of "greened" national accounts to the more modest goal of complementary headline indicators that, taken together, can capture economic performance, human well-being and sustainability. There is now a renewed interest and momentum on the part of policy-makers and researchers in developing headline indicators that go beyond economics to more comprehensively assess societal progress. Examples are the high-level conference 'Beyond GDP'[4] which took place in November 2007 and the establishment of the 'Commission on the Measurement of Economic Performance and Social Progress'[5] (Stiglitz Commission) by French President Nicolas Sarkozy.

1.2 Objectives of the Project

The objective of the IN-STREAM project is to undertake the qualitative and quantitative assessments necessary for linking mainstream economic indicators with key well-being and sustainability indicators, thus providing needed insight into the synergies and trade-offs implicit in Europe's simultaneous pursuit of economic growth and environmental sustainability. The project has the following key objectives:

Qualitative analysis objectives

1. **Evaluate key indicators and indicator efforts.** Research will result in a summary evaluation of mainstream economic indicators (especially GDP) as well as selected measures designed to incorporate sustainability concerns (especially environmental metrics). Policy-makers and researchers need a guidance regarding what is feasible, what is useful, and how indicator efforts can be adapted to supplement the national level data collection that Eurostat and national governments currently undertake. Of particular interest for the assessment will be the ability of mainstream economic indicators to assess progress towards the objectives of the SDS, as well as the ability of sustainable

[4] See http://www.beyond-gdp.eu/
[5] See http://www.stiglitz-sen-fitoussi.fr/

development (SD) indicators to yield insights into the economic implications of pursuing sustainable development.

2. **Evaluate institutional needs and opportunities.** Central to the qualitative analysis will be an effort to understand the key drivers and obstacles to institutional adoption of the reviewed indicators. Through stakeholder participation and outreach activities, the project will seek to increase the level of knowledge and acceptance among key policy-makers and statistical offices of an integrated approach to assessing economic growth, human well-being and sustainable development. It will also help clarify the way forward, developing a road map for development at EU level with insights from national practice.

Quantitative analysis objectives

3. **Improve quantitative models linking indicators.** The project will build on previous modeling and statistical work that has attempted to bridge the gap between macroeconomic indicators and sustainability measures, particularly the GARP,[6] GREENSTAMP, GREENSENSE (FP5),[7] and MOSUS (FP5)[8] projects, as well as the more recent research efforts INDI-LINK (FP6)[9] and EXIOPOL (FP6).[10]

4. **Assess the costs of reaching sustainability targets.** Using the models developed in the project, forecasts for selected Member States will be generated, using both partial and general equilibrium techniques. The analyses will estimate the expected costs in traditional economic terms of pursuing targets for selected sustainability indicators.

Summary evaluation objectives

5. **Recommend composite indicator approaches and implementation strategies.** Based on the qualitative and quantitative analyses, recommendations for new indicator approaches will be proposed. Recommended indicators (and sets of indicators) will be those that perform best in terms of their robustness, feasibility and suitability to EU policy objectives. Strategies for implementing these approaches will be identified and developed in consultation with stakeholders. The recommended indicator approaches

[6] See http://www.cru.uea.ac.uk/cru/projects/wise/feem.htm
[7] See http://people.bath.ac.uk/hssam/greensense/home.html
[8] See http://www.mosus.net/
[9] See http://www.indi-link.net/
[10] See http://www.feem-project.net/exiopol/

should not only aim at complementing GDP in policy debates but also at establishing links with the Lisbon and Maastricht criteria.

1.3 Structure of the Research Note

This research note aims to lay out the strategy and concept for (a) identifying the set of indicators to be evaluated by IN-STREAM, (b) the evaluation methodology of the selected indicators, and (c) conclusions, albeit preliminary, about which indicators and sets of indicators best meet the objectives specified in Section 1.2 above.

The remainder of the research note is structured as follows. Part 2 sets the background by establishing the policy context for the analysis. It specifically looks at the historical policy background starting with the Rio Summit in 1992 and its impetus for EU work on sustainable development and its measurement. The economic context is provided by the Lisbon Strategy and to a lesser extent by the Maastricht Treaty (see Part 2).

Part 3 explains the methodology for choosing and evaluating the indicators and forms the core of the research note. It elaborates on two existing evaluation methodologies, RACER and SWOT, and how they have been adapted to provide more nuanced indicator analyses. It then explains the selection criteria for the indicators, beginning with a basket of measures from Eurostat.

Part 4 contains first results from the pilot study in the form of indicators assessments for three prominent economic measures or frameworks of sustainable development: Gross Domestic Product, the System of Integrated Environmental and Economic Accounting, and the Adjusted Net Savings indicator. These approaches were chosen because they represent the body of mainstream eco-environmental work that originated from and has since expanded the national economic accounting framework(s). As the work in IN-STREAM progresses, further indicators will be evaluated and added to Part 4. All evaluations use the same template whose development is explained in Part 3.

Recognizing that a single indicator of sustainable development has thus far remained elusive, Part 6 is dedicated to the joint evaluation of groups of indicators that complement each other in the aspects they measure and that, taken as a whole, can illuminate better the degree to which an economy is on a sustainable path. In this research note GDP is evaluated in conjunction with the ANS indicator and the SEEA framework.

Part 7 discusses methodological issues that remain unsolved. Some of which may still be addressed within the IN-STREAM plan of work but mostly this part highlights more general issues in the evaluation of indicators for integrated eco-environmental assessment of sustainability, for example, the need for but persistent lack of accepted methods to score indicators and also the need to communicate uncertainty in a transparent manner in measures of sustainability.

Part 8 concludes with a summary of the findings and conclusions that can be drawn from the state of work accomplished to date in IN-STREAM.

2 EU Policy Context

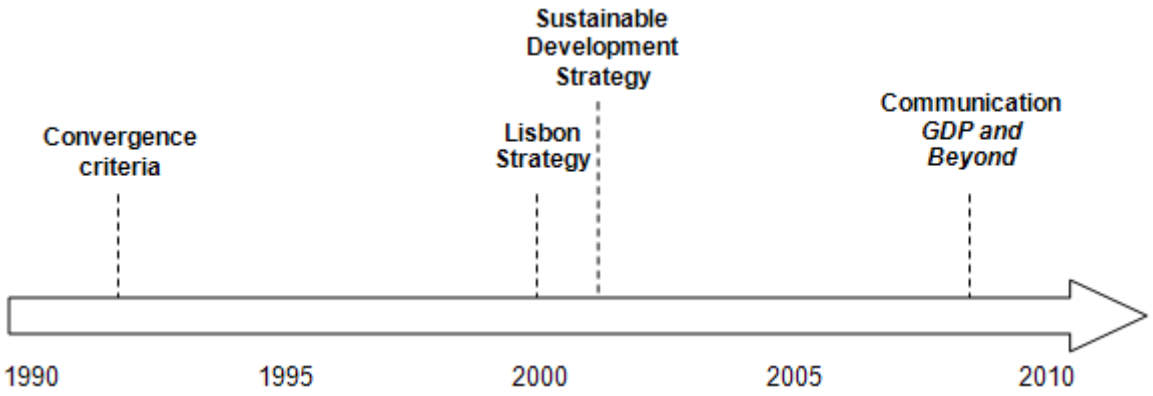
The 1992 UN Conference on Environment and Development (UNCED) and resulting Agenda 21 provide the foundation for the EU's commitment to sustainable development.[11] The EU's overarching goal of balancing economic, social and environmental well-being has since become a central tenant in three key EU policy areas: the Lisbon Strategy, the Sustainable Development Strategy and (to a lesser extent) the Maastricht criteria. However, a key question remains on how to best measure progress toward sustainability goals. This study focuses on identifying which indicators, and sets of indicators, are most effective for monitoring progress toward this policy objective.

2.1 Policy Timeline

The Lisbon Strategy, agreed by the Lisbon European Council in March 2000, aims to increase competitiveness and employment within the EU. Following the model of the Maastricht criteria, which determine Member State entry into the European Economic and Monetary Union (EMU), it identifies goals and objectives to improve Member State economies (Collignon, 2006). However, the Lisbon Strategy was immediately criticised for ignoring the environment in its socio-economic goals. Therefore, at the June 2001 Gothenburg European Council, the European Commission adopted the Sustainable Development Strategy, which aimed to provide an environmental pillar to the Lisbon Agenda.

[11] The Treaty Establishing the European Community (Article 2) establishes sustainable development and protection of the environment as a core principle of the European Community, tasking the Community to promote a "harmonious, balanced and sustainable development of economic activities" and "a high level of protection and improvement of the quality of the environment", among other key goals.

Figure 2 Policy timeline



In 2006, the Lisbon Strategy and the SDS were separately revised and renewed. Both revisions promote enhanced communication among local, national and EU levels of government to achieve stated objectives and create mechanisms for frequent evaluation. The revised Lisbon Strategy aims to streamline the co-operation between the Commission and the Member States and focuses on two primary targets for 2010: 1) invest 3% of Europe's GDP in research and development, and 2) reach an employment rate of 70%. Similarly, the revised SDS sets enhanced objectives and action items for seven key priority areas and proposes ways to improve government co-ordination. A key contribution is the clarification of its synergies with the Lisbon Strategy (Steinbuka and Wolff, 2007). The revised SDS is to be reviewed every two years to monitor progress towards its goals.

The 2009 review of the SDS highlights the opportunity presented by the global financial crisis to include incentives in economic stimulus and recovery packages and to promote regulatory changes with a view toward shifting to a low-carbon economy. It emphasizes the synergies with the Commission's Recovery Plan from November 2008, and focuses on green growth as a goal for both the SDS and the Lisbon Strategy. The accompanying monitoring report, due later this year from Eurostat, will likely echo this review, which states that indicators of sustainable development are still needed and "the Commission is exploring the possibilities of developing an SD scoreboard" (CEC, 2009a). In 2007, the international conference 'Beyond GDP' expressed the Commission's will to investigate possibilities to integrate economic indicators with sustainability principles. The recent Communication 'GDP and beyond, Measuring progress in a changing world' sends a strong message regarding the need to complement GDP with environmental and social indicators. It commits the EU to five actions by 2012, including the establishment of an SD scoreboard to be piloted in 2009 (CEC, 2009b).

The following section provides further detail on three key policy areas: the Maastricht criteria, the Lisbon Strategy, and the Sustainable Development Strategy. Furthermore, the recent Communication 'GDP and beyond' will be described. This integrated policy framework provides a backdrop for the indicator analyses performed for this study, and shows the timeliness of this research. Among the mentioned initiatives, the Lisbon Strategy and the Sustainable Development Strategy are most relevant for IN-STREAM, as they define the economic and sustainability goals of the EU.

2.2 Maastricht Criteria

With the adoption of the Maastricht Treaty on European Union (TEU) by the European Council in 1992, the EU implemented the single market and entered the final stage for the completion of the Economic and Monetary Union. The main objective of EMU was the establishment of an area of monetary stability. A high degree of sustainable convergence of the economies of the Member States is a precondition for EMU.[12] The convergence criteria – commonly known as the Maastricht criteria – comprise:[13]

- Price stability – reflected by a rate of inflation which is not more than 1.5 percentage points above the rate of the three best-performing Member States;
- Sound public finances – reflected by a government deficit that is no higher than 3% of GDP;
- Sustainable public finances – reflected by a government dept that is no higher than 60% of GDP;
- Exchange rate stability – reflected by normal fluctuation margins provided by the exchange rate mechanism (ERM) for at least two years, without devaluing against the currency of any other Member State;
- Durability of convergence – reflected in long-term interest-rate levels that are not more than 2 percentage points above the rates of the three best performing Member States.

[12] As stipulated in Article 121(1) TEC.
[13] See European Commission – Economic and Financial Affairs: http://ec.europa.eu/economy_finance/the_euro/joining_euro9413_en.htm

Stability and Growth Pact. In 1997, the European Council adopted the Stability and Growth Pact (SGP),[14] which aimed to facilitate EMU by strengthening the convergence criteria. In 2004, the Commission issued a Communication on strengthening economic governance and clarifying the implementation of the SGP and a year later, the EU finance ministers reached agreement on better management procedures for the SGP. A code of conduct (CEC, 2005a) specifies the medium-term budgetary objective (MTO)[15] and the related rules and procedures. As an essential component, the code of conduct also lays down the process regarding the excess deficit procedure (EDP).[16] Furthermore, it provides guidelines on the format and content of Member States' stability and convergence programmes.

The goals enshrined in the Maastricht Treaty specify little in terms of competitive growth and employment and even less regarding sustainable development. However, the Maastricht Treaty is the foundation without which the Lisbon and SDS strategies could not have been built. Maastricht was aimed at sustainability of a different light, namely the sustainability and potential for lasting growth of the Union by specifying macro-economic performance criteria and a code of conduct that would lead to the gradual conversation of the economies of the Member States under the umbrella of steady, stable, and positive growth.

Box 4 Maastricht criteria – further links

- European Central Bank – Economic and Monetary Union: http://www.ecb.int/ecb/history/emu/html/index.en.html
- European Commission – Stability and Growth Pact: http://ec.europa.eu/economy_finance/sg_pact_fiscal_policy/index_en.htm?cs_mid=570

2.3 The Lisbon Strategy – A Response to Socio-economic Challenges

Toward the end of the 1990s, in an increasingly globalized world, the EU was faced with demographic change and decreasing international competitiveness. In 2000, the European

[14] The SGP was adopted on the basis of Articles 99 and 104 TEC.
[15] The MTO serves as a preventive arm of the SGP and pursues a triple aim by providing a safety margin with respect to the 3% budgetary deficit limit, ensuring rapid progress towards sustainability, and taking the first two points into account, allowing room for budgetary manoeuvre, in particular taking into account the needs for public investment.
[16] As laid down in Article 104(3) TEC.

Council agreed on the Lisbon Strategy for Growth and Competitiveness, which aims at making the EU "the most dynamic and competitive knowledge-based economy" in the world. The following outlines the key components of the Strategy.

Central targets. The Lisbon Strategy has set up two central targets, which are to be achieved by 2010:

- investing 3% of the EU's GDP in research and development (R&D) activities; and
- reaching an employment rate of 70%.

Key strategies. Strategies for reaching these targets include: better policies for the information society and R&D; structural reforms for competitiveness and innovation; completion of the internal market; and a modernization of the European social model. Macro-economic policy shall ensure economic growth, which is seen as a prerequisite for maintaining and increasing prosperity and thus for preserving and enhancing the European social model. Demographic change is also identified as a major challenge that needs to be addressed. In order to be able to finance increasing pensions and health care costs, economic growth is regarded as a means to generate taxes and contributions by businesses and the working population.

Environmental dimension. In 2001, the European Council decided that a "strategy for sustainable development which completes the Union's political commitment to economic and social renewal, adds a third, environmental dimension to the Lisbon Strategy." The heads of state and government concluded that "clear and stable objectives for sustainable development will present significant economic opportunities" (European Council, 2001). Environmental protection should lead to technological innovation and increased investment spending, which, in turn, should result in economic growth and increased employment. In 2006, the Sustainable Development Strategy was renewed to provide "a single, coherent strategy on how the EU will more effectively live up to its long-standing commitment to meet the challenges of sustainable development" (CEC, 2005c).

Key measures. After a mid-term review (CEC, 2005d) showed that little progress has been made in terms of achieving the goals, it was decided in 2005 to relaunch the Lisbon Strategy with a stronger focus on growth, employment and better regulation (European Council, 2005). In the 2005 Community Lisbon Programme, the Commission has grouped several initiatives into eight key measures (CEC, 2005b):

- support of knowledge and innovation;
- reform of state aid policy;
- simplification of the regulatory framework;
- completion of the internal market for services;
- global agreement on the Doha round;
- removal to obstacles to physical, labour and academic mobility;
- development of a common approach to economic integration;
- support of efforts to deal with the social effects of economic restructuring.

Priority areas. Finally, in 2006, the Commission defined four priority areas as the pillars of the renewed Lisbon Strategy (CEC, 2006). These are:

- knowledge and innovation;
- unlocking business potential;
- investing in people and modernising labour markets; and
- energy and climate change.

The National Reform Programmes (NRPs) for Growth and Jobs are a key part of the economic reform process. Their aim is to explain to the public what the Lisbon Agenda means in practice and to highlight progress and commitments in all Member States. In their NRPs, the Member States define their political priorities with regard to achieving the goals of the Lisbon Strategy. In achieving the objectives of the Lisbon Strategy, the Member States must follow the Integrated Guidelines for Growth and Jobs, which have been set up by the Commission. They are required to publish implementation reports, the so-called Annual Progress Reports (APR). On the basis of these reports, the Commission assesses the progress made by each Member State in achieving the objectives of the Lisbon Strategy.

Programmes and tools. The Lisbon Strategy is flanked by a number programmes and tools, which aim at supporting the achievement of the defined goals. These include:

- the EU's Seventh Framework Programme (FP7) for Research and Technological Development;
- the Joint Technology Initiatives (JTIs);
- the new Competitiveness and Innovation Framework Programme (CIP);
- the Structural and Cohesion Funds;
- education and training programmes; and
- the EU's strategy for better regulation.

Structural indicators. In order to have a stable statistical basis for assessing the Lisbon Strategy, a set of 14 structural indicators[17] has been set up. It is monitored by Eurostat – *inter alia* to support the Commission's analysis of the Annual Progress Reports, in which Member States declare the progress made in achieving the objectives of the Lisbon Strategy. The following structural indicators cover six issue areas:

1. General Economic Background

- GDP per capita in PPS
- Labour productivity

2. Employment

- Employment rate
- Employment rate of older workers

3. Innovation and Research

- Youth education attainment level by gender
- Gross domestic expenditure on R&D

4. Economic Reform

- Comparative price levels
- Business investment

5. Social Cohesion

- At risk-of-poverty rate after social transfers
- Long-term unemployment rate
- Dispersion of regional employment rates

6. Environment

- Greenhouse gas emissions
- Energy intensity of the economy
- Volume of freight transport relative to GDP

In the interpretation of the Lisbon Strategy, economic growth is regarded as the basis for prosperity. One key indicator used to monitor economic performance is GDP, which measures the total market value of all final goods and services produced within the country

[17] Eurostat Structural indicators available at http://epp.eurostat.ec.europa.eu/portal/page?_pageid=1133,47800773,1133_47802588&_dad=portal&_schema=PORTAL

or region in a given period of time. Among Eurostat's 'selected principal European economic indicators', GDP takes a preeminent position. Eurostat releases national GDP figures as well as aggregates for the EU as a whole.

Current status. The two key targets of the Lisbon Strategy (i.e. investment in R&D and employment rate) are not expected to be reached within the 2010 timeframe. The financial crises that triggered a global recession in late 2007 also affected the EU area, depressing economic activity and causing increases in unemployment (9.5% in the Euro area, 9.0% in the entire EU). To counter-act the effects, many European countries enacted stimulus packages and the EU is working to boost international trade.

Despite these actions, there is intense debate surrounding the development of the Lisbon Strategy post-2010. Among other things, education is cited as a key element for progress in economic competitiveness. Educational achievement levels of several EU Member States lag behind those of the OECD average (e.g., Germany's low enrolment rates in tertiary institutions) and investment in this area could lead to threefold returns including higher employment rates, long-term economic growth through increased innovative potential, and strengthened social cohesion (Gros and Roth, 2008).

The financial and economic crisis is also cited as a reason to focus even more strongly on implementing the Lisbon objectives. The European Economic and Social Committee (EESC) in July 2008 created the Lisbon Strategy Observatory in preparation for the review of the Lisbon Strategy and the new cycle 2008-2012. Its goal is to foster implementation of the strategy in Member States through increased stakeholder exchange and participation and will prepare the report "*Integrated Report on the implementation and the future of the Lisbon Strategy in the post - 2010 period*" to be presented to the Spring Council 2010.[18]

Box 5 Lisbon Agenda – further links

- The Lisbon Strategy: http://ec.europa.eu/growthandjobs/index_en.htm
- Integrated Guidelines for Growth and Jobs (2005-2008): http://ec.europa.eu/growthandjobs/pdf/COM2005_141_en.pdf
- National Reform Programmes (2008-2010): http://ec.europa.eu/growthandjobs/national-dimension/member-states-2008-2010-reports/index_en.htm
- Annual Progress Reports (APR) (2007): http://ec.europa.eu/growthandjobs/european-dimension/200712-annual-progress-report/index_en.htm

[18] See European Economic and Social Committee (EESC) – The Lisbon Strategy Observatory: http://eesc.europa.eu/lisbon_strategy/index_en.asp.

- Competitiveness and Innovation Framework Programme (CIP): http://ec.europa.eu/cip/index_en.htm
- Seventh Framework Programme: http://cordis.europa.eu/fp7/
- Joint Technology Initiatives (JTIs): http://www.e2b-jti.eu/default.php
- EU Structural Funds: http://ec.europa.eu/regional_policy/funds/prord/sf_en.htm
- EU Cohesion Fund: http://ec.europa.eu/regional_policy/funds/procf/cf_en.htm
- Education & Training programmes: http://ec.europa.eu/education/index_en.htm
- Better Regulation Strategy: http://ec.europa.eu/governance/better_regulation/index_en.htm
- Eurostat GDP and main aggregates figures: http://epp.eurostat.ec.europa.eu/portal/page?_pageid=1996,45323734&_dad=portal&_schema=PORTAL&screen=welcomeref&open=/t_na/t_nama/t_nama_gdp&language=en&product=REF_TB_national_accounts&root=REF_TB_national_accounts&scrollto=0

2.4 Sustainable Development Strategy

The European Union considers sustainable development a global objective and is committed to its implementation inside Europe and around the world. Internationally, the EU is a signatory to the 1992 United Nations Rio Declaration. At the 19th Special Session of the United Nations' General Assembly in 1997, the EU committed itself to developing a sustainable development strategy for the 2002 World Summit on Sustainable Development. The strategy developed in 2001 formed part of the EU's preparation for the World Summit, as well as being integrated into the EU's broader (and domestic) Lisbon Strategy.

As done for the Lisbon Strategy, the European Commission also reviewed its Sustainable Development Strategy and, in light of EU expansion and slow progress toward meeting the initial set of goals, saw the need for expedited action in the face of negative trends. In response, the European Commission developed a renewed Sustainable Development Strategy in 2006.

Overarching objectives. In the development of the renewed Strategy, policy-makers paid special attention to areas of overlap and possible integration with the Lisbon Agenda and identified four key overarching objectives:

- Environmental protection;
- Social equity and cohesion;
- Economic prosperity;

- Meeting our international responsibilities.

Key challenges. The renewed Strategy identified seven key challenges and established a set of targets and actions to guide progress in each area. The Strategy also created a bi-annual review process, through which policy-makers in the EU and also in Member States could see progress made (and not made) in addressing these challenges. Importantly, strong links exist between the key challenges of the renewed Strategy and the Lisbon Agenda, whereby addressing the Strategy's key challenges are also positive outcomes from the Lisbon perspective. Of course, the links between the Renewed Strategy and the Lisbon Agenda also mean trade-offs. Resources put to use on developing energy infrastructure or supporting sustainable transport come at the expense of other possible projects and could even damper the achievement of some of the Lisbon objectives. Both sides of the connection – positive and negative – must be considered. The seven key challenges are:

- Climate change and energy;
- Sustainable transport;
- Sustainable consumption and production;
- Conservation and management of natural resources;
- Public health;
- Social inclusion, demography and migration;
- Global poverty and sustainable development challenges.

Targets and actions. Each challenge is framed by an overall objective, as well as a list of targets and actions in order to meet the challenge. Using climate change and energy as an example, the overarching objective is to "limit climate change and its costs and negative effects to society and the environment" and the targets are:

1. Fulfil the EU's Kyoto commitments;
2. Renewable sources of energy will be 12% of the EU total and 21% of electricity consumption by 2010 (option to raise to 15% by 2015);
3. 5.75% of transport fuel from biofuels by 2010;
4. Overall savings of 9% of final energy consumption over 9 years until 2017.

To meet these climate and energy targets, the SDS proposes a number of actions. These actions include: developing a long-term European plan on energy efficiency; reviewing and extending the EU Emissions trading scheme; promoting power station efficiency and the expanded use of combined heat and power; creating a plan to cost-effectively increase the

use of renewable energy; and exploring options, working with partners, and offering suggestions for a new climate agreement to follow Kyoto.

Current status. The second biennial review of the SDS was completed in July 2009. It highlights opportunity for green growth and a switch to a low-carbon economy, especially in light of the current global financial crisis. A summary of policies since 2007 shows the EU aims to integrate the principle of sustainable development into all policy areas and presents an honest perspective as to how the strategy can be improved. In particular, it highlights the difficulty in merging the key cross-cutting strategies, i.e., Lisbon Strategy, but calls for 'jointly identified objectives, measuring instruments (indicators, guidelines), benchmarking (comparison of Member States' performance)' between the Lisbon Strategy and SDS (CEC, 2009a). A key component of strengthening sustainable development is improving indicators of sustainable development for effective monitoring of progress toward this overarching goal.

Box 6 Sustainable Development Strategy – further links

- Mainstreaming sustainable development into EU policies: 2009 Review of the European Union Strategy for Sustainable Development: http://ec.europa.eu/environment/eussd/
- Renewed EU Sustainable Development Strategy (2006): http://register.consilium.europa.eu/pdf/en/06/st10/st10917.en06.pdf
- European Commission First Progress Report on the Renewed Strategy: http://ec.europa.eu/sustainable/docs/com_2007_642_en.pdf
- Commission Staff Working Document for First Progress Report: http://ec.europa.eu/sustainable/docs/sec_2007_1416_en.pdf
- Eurostat Sustainable Development monitoring report (2007): http://epp.eurostat.ec.europa.eu/portal/page?_pageid=1073,46587259&_dad=portal&_schema=PORTAL&p_product_code=KS-77-07-115
- European Council conclusions from progress report: http://www.consilium.europa.eu/ueDocs/cms_Data/docs/pressData/en/ec/97669.pdf
- The Gothenburg Sustainable Strategy (2001): http://ec.europa.eu/sustainable/sds2001/index_en.htm

2.5 GDP and Beyond: Measuring Progress in a Changing World

In August 2009, the Commission released its Communication 'GDP and beyond: Measuring progress in a changing world' in response to strong support from *inter alia* the international community to develop indicators that measure progress beyond traditional macro-economic indicators, leading among them GDP. The Communication echoes the 2009 review of the

SDS in calling for a rapid transition to a low-carbon economy, and states that sustainability indicators 'could contribute to setting new strategic goals for the post-2010 Lisbon Strategy'.

The Communication outlines five action items that the Commission will implement to improve the measurement of progress by 2012:

1. **Develop indicators to complement GDP.** The Commission intends to pilot its comprehensive environmental index in 2010. The index will measure negative environmental effects related to a broad range of environmental policy areas. The Commission has studied the potential for quality of life and well-being indicators, but there are no concrete plans to launch a new initiative in this area.[19]

2. **Improve data availability.** The Communication recognises that environmental and social data is often out of date, making it difficult to measure progress in areas beyond the economy. The Commission will support technological developments to allow for 'near real-time reporting' and work to streamline surveys to collect social data.

3. **Improve reporting on distribution and inequality.** The EU is committed to reducing inequality across and within regions of Europe. Indicators are being developed that measure equal access to e.g., housing and transport.

4. **Develop European Sustainable Development Scoreboard.** The Commission intends to pilot the SD Scoreboard in 2009. The scoreboard will be based on the EU Sustainable Indicator set and may include additional up-to-date information.

5. **Expand European System of Accounts beyond traditional economic indicators.** The European System of Accounts will be extended to include aspects of sustainable development. Environmental indicators will be implemented first, followed by social indicators as data becomes available.

The Communication clearly states that GDP is "still the best single measure of how the market economy is performing", but is not enough to capture all important aspects of peoples' lives. The ongoing research on indicator development at the international, national

[19] The importance of developing well-being indicators was reiterated at the recent presentation o fand discussion of the communication by the Commission on 8 September 2009.

and EU levels is expected to be revitalised by the EU's commitment to these five actions over the next four years. The Communication builds on the goals of the Lisbon Strategy, Sustainable Development Strategy and (to a lesser extent) the Maastricht criteria, as described above.

3 Evaluation Methodologies

In order to evaluate the capacity of indicators to complement and expand the message sent by mainstream macro-economic indicators, most of all GDP, the IN-STREAM needed to develop a comprehensive indicator selection and evaluation methodology. The foundation is laid by three existing approaches for the development and evaluation of indicators and programs: the RACER approach, the SWOT approach, and the European Commission's SDI criteria for indicator selection. While these approaches certainly allow a grouping of indicators according to their capacity to meet the stated objectives, they were found to be insufficient for characterizing the specific policy linkages and methodological nuances that set them apart. IN-STREAM therefore combined the three approaches and expanded them to include additional items on policy relevance, complementarity, capacity to bridge economic and environmental and economic and social aspects as well as their utility as baskets of indicators. Each approach and Ecologic's adjustments or extensions of it is explained in the following paragraphs.

3.1 RACER Analysis

The European Commission's Impact Assessment Guidelines" (European Commission, 2005) specify the so-called RACER criteria for useful indicators. It is an evaluation framework developed for assessing the value of scientific tools for use in policy making. RACER is an acronym for:

Relevant = closely linked to the objectives to be reached

Accepted = by staff, stakeholders, and other users

Credible = accessible to non experts, unambiguous and easy to interpret

Easy = feasible to monitor and collect data at reasonable cost

Robust = not easily manipulated

We developed additional sub-criteria, shown in detail in the Technical Annex and summarized below, which aim at making the meaning of each RACER criterion more explicit, tailor it to the specific objectives of IN-STREAM, and to bring to the fore the more nuanced differences among the selected indicators. These sub-criteria have already been successfully applied in the project "Potential of the Ecological Footprint for monitoring environmental impacts from natural resource use" which was carried out for the European Commission's DG Environment (Best, Giljum et al., 2008).

Relevant

- Policy support, identification of targets and gaps
- Identification of trends
- Forecasting and modelling
- Scope/levels of application
- Function- and needs-related analysis

Accepted

- Stakeholder acceptance

Credible

- Unambiguous
- Transparency of the method

Easy

- Data availability
- Technical feasibility
- Complementarity and integration

Robust

- Defensible theory
- Sensitivity
- Data quality
- Reliability
- Completeness

3.2 SWOT Analysis

SWOT analysis stands for Strengths – Weaknesses – Opportunities – Threats and is a tool for assessing an organization's, business' or program's ability to achieve a stated objective. It evaluates the internal and external factors that influence the probability of success of the objective and is credited to Albert Humphrey at Stanford University who used it for evaluating Fortune 500 companies in the 1960s and 1970s.

	Helpful To achieving the objective	Harmful To achieving the objective
Internal origin attributes of the organization	Strengths	Weaknesses
External origin attributes of the environment	Opportunities	Threats

Table 2 Visualization of the four poles of a SWOT analysis.

Source: adjusted from Wikipedia, http://en.wikipedia.org/wiki/SWOT_analysis (last accessed, 26 August 2009).

In this study, the objects to be evaluated are the indicators, individually and in groups. For this purpose, we adapted and defined the SWOT criteria as follows:

Strengths

- Positive aspects of the methodology/indicator grouped as 'core' or 'important' strengths (core = specific to methodology/indicator, important = shared with other methodologies/indicators).

Weaknesses

- Negative aspects of the methodology/indicator re-categorized into critical and important weaknesses (critical = inadvisable to use methodology/indicator; important = limiting usefulness of methodology/indicator)

- Third category: outside the scope of the methodology/indicator' and to be covered by complementary indicators.

Opportunities

- Those aspects of the institutional, political, intellectual and technological environments that could help improve the methodology/indicator, lead to its successful adoption, or both.

Threats

- Those aspects of the institutional, political, intellectual and technological environments that could hinder the successful adoption of the methodology/indicator.

3.3 SDI Criteria for Indicator Selection

The Sustainable Development Strategy adopted by the European Council in 2001 (renewed in 2006) entails a commitment to regular monitoring: "[The Strategy will be] *comprehensively reviewed at the start of each Commission's term of office*" (SDS, 2001). A Sustainable Development Indicator Task Force was created to develop the indicators that would allow such monitoring and also inform decision-makers and the general public about achievements, trade-offs, and failures in attaining the agreed upon objectives of the SDS.

The Task Force subsequently developed indicator selection criteria as outlined in the Communication "Sustainable Development Indicators to monitor the implementation of the

EU Sustainable Development Strategy" (2005) to the Members of the Commission. These criteria govern the selection of individual metrics and sets principles, which the collection of selected indicators should follow. They are:

Individual indicator criteria:

- An indicator should capture the essence of the problem and have a clear and accepted normative interpretation.
- An indicator should be robust and statistically validated.
- An indicator should be responsive to policy interventions but not subject to manipulation.
- An indicator should be measurable in a sufficiently comparable way across Member States, and comparable as far as practicable with the standards applied internationally by the UN and the OECD.
- An indicator should be timely and susceptible to revision.
- The measurement of an indicator should not impose on Member States, on enterprises, nor on the Union's citizens a burden disproportionate to its benefits.

Portfolio principles:

- The portfolio of indicators should, as far as possible, be balanced across different dimensions.
- The indicators should be mutually consistent within a theme.
- The portfolio of indicators should be as transparent and accessible as possible to the citizens of the European Union.

3.4 Correspondence between SDI Criteria and IN-STREAM Evaluation Methodologies

There is substantial agreement and correspondence between the SDI Task Force criteria and the evaluation methods synthesized and further developed as part of the IN-STREAM project, which is demonstrated in a cross-walk Table 3. This led us to integrate the SDI criteria into our suite of assessment criteria.

SDI criteria	RACER criteria	RACER sub-criteria
Individual indicator selection criteria.		
An indicator should capture the essence of the problem and have a clear and accepted normative interpretation.	Relevant	Policy support, identification of targets and gaps
	Accepted	Stakeholder acceptance
	Credible	Unambiguous
An indicator should be robust and statistically validated.	Robust	Defensible theory
		Sensitivity
		Data quality
		Reliability
		Completeness
An indicator should be responsive to policy interventions but not subject to manipulation.	Relevant	Policy support, identification of targets and gaps
	Robust	Sensitivity
	Credible	Unambiguous
An indicator should be measurable in a sufficiently comparable way across Member States, and comparable as far as practicable with the standards applied internationally by the UN and the OECD.	Relevant	Scope/levels of application
An indicator should be timely and susceptible to revision.	Robust	Sensitivity
The measurement of an indicator should not impose	Easy	Data availability

on Member States, on enterprises, nor on the Union's citizens a burden disproportionate to its benefits.		
Portfolio criteria:		
The portfolio of indicators should, as far as possible, be balanced across different dimensions.	Synergy between indicators	
The indicators should be mutually consistent within a theme.	--	--
The portfolio of indicators should be as transparent and accessible as possible to the citizens of the European Union.	Easy	Data availability
	Credible	Unambiguous

Table 3 SDI Task Force criteria and RACER criteria

3.5 Final Indicator Set

The scoping paper specified which criteria the selected indicators – individually and as a group – should meet to be considered in the IN-STREAM project. These criteria were partially binding (selection filters) and non-binding (selection criteria). Details regarding the specification of the initial indicator list and the application of the criteria are not repeated here but can be reviewed in the scoping paper.

4 Single Evaluations of the Selected Indicators

This Chapter of the report presents the evaluation of three pilot indicators:

- Gross domestic product (GDP);

- System of Integrated Environmental and Economic Accounting (SEEA);
- Adjusted Net Savings (Genuine Savings).

4.1 Gross Domestic Product

GDP is the most prominent and widespread indicator for measuring an economy's performance. However, it does entail a number of shortcomings. For instance, it does not include non-market transactions, such as voluntary, unpaid services, nor the 'black economy'. Furthermore, GDP considers investment in capital but ignores the depreciation of capital. It does not account for human capital and gives no indication of the distribution of wealth (especially when quoted as per capita GDP) and only considers income flows, not stocks, while standard of living considerations should include stocks of wealth.

Despite its shortcomings as an indicator of human wellbeing or sustainability, the long history of its development and ubiquitous use in economic reporting mean that the data and methodological bases are generally well developed, it is calculated frequently with reliable and robust quality, and is generally seen as the most important structural indicator. GDP is therefore not likely to disappear from national balance sheets any time soon.

I. Indicator Summary	
Name of indicator	Gross domestic product (GDP) per capita
Indicator category	Economic
II. Background information on the indicator	
a. What is the official definition of the indicator?	GDP is an aggregate measure of aggregate economic activity within the national account systems (NAS). According to the official definition, GDP measures, in monetary terms, income and output for a country's or region's economy. It is defined as the total market value of all final goods and services produced within a country or region in a given period of time (OECD, 2002). While GDP values all goods and services produced *within* a country or region, gross national product (GNP) adds the income earned by its citizens *abroad* and subtracts the income earned by foreigners within the country or region.
b. Unit(s) of measurement of the indicator	In the EU, the GDP's unit of measurement is the euro or – where applicable – national currencies, expressed in Purchasing Power Standards (PPS) at current prices or in volume terms (Eurostat, 2009). On a global scale, GDP is usually expressed in current, constant, or international US dollars.
c. What does the indicator seek to measure?	GDP is a measure for the economic activity within a certain country or a region. This is possible in three ways: 1. By measuring the total spending on all final goods and services (expenditures approach): *(Consumption goods and services (C) + Gross Investments (I) + Government Purchases (G) + (Exports (X) - Imports (M))* 2. By adding up the factor incomes to the factors of production in the society (income approach):

	Employee compensation + Corporate profits + Proprietor's Income + Rental income + Net Interest 3. By valuing the sales of goods (value added approach): *Value of sales of goods - purchase of intermediate goods to produce the goods sold.*
d. Provide a brief history of the indicator. Which organization or body originally proposed the indicator (and in what year)? Which organizations currently advocate for the indicator's use?	GDP has its roots in the aftermath of the Great Depression (1929 – mid 1930s). In the early 1930s, Simon Kuznets was commissioned by the US National Bureau of Economic Research to "develop a set of national accounts" in order to have a measurement for the effects of the Depression. In the early 1940s, estimates of national income were complemented by annual estimates of gross national product, and input-output accounts were developed. This development was also spurred by demands of economic planners and decision-makers during World War II, when it turned out to be crucial to be well-informed about the state of the national economy (Bureau of Economic Analysis, 2000). After World War II, GDP was also introduced in Europe and quickly became the main indicator for a nation's economic performance.
e. What are the known limitations of the indicator?	GDP implies a range of limitations; the following list outlines the key problems: • GDP does not include non-market transactions, such as voluntary, unpaid services. • GDP does not take into account the 'black economy' - • GDP considers investment in capital but ignores the depreciation of capital. Depreciation is usually relatively constant when the structure of production stays the same - in this case capital depreciation would be a relatively constant deduction from GDP. However, this is not the case. US and European economies have become more technology-based. This shift in the structure of production means that depreciation of capital has concomitantly changed. In this case, ignoring capital depreciation could be an enormous oversight. • GDP does not account for human capital, which can account for 80% or more of all wealth (Stiglitz, Sen and Fitoussi, 2009b). • GDP does not account for depletion of natural capital or ecosystem quality. In contrast, GDP increases if natural resources are (over-) depleted. • GDP considers only income flows, not stocks, while standard of living considerations should include stocks of wealth. • GDP per capita measures do not account for household size and does not incorporate household services, which could equate to 30-40% of GDP. • GDP gives no indication of the distribution of wealth. It caters to the statistical mean and does not capture the spectrum of experience from wealthy to poor in a particular country. These limitations of GDP have also been addressed by the Stiglitz Commission (Stiglitz, Sen and Fitoussi, 2008; 2009b).
f. What is the history and status of the methodological development and adoption of the indicator (e.g. major revisions, current efforts, future plans/initiatives)?	With regard to methodological developments of national income accounts, a number of innovations and adjustments have taken place since its first application in the early 1930s (Bureau of Economic Analysis, 2000): • development of product or expenditure estimates (early 1940s); • evolvement into a consolidated set of income and product accounts (mid 1940s); • development of official input-output tables and capital stock estimates (late 1950s); • integration of more detailed and timely regional and local personal income estimates (early 1960s); • improvement of measures of prices and inflation-adjusted output (late 1960's and 1970's); • expansion of estimates of international trade in services (1980s); • development of quality-adjusted price and output measures for computers (1980s); • introduction of more accurate measures of prices and inflation-adjusted output (1990s). Today, GDP is applied on a world-wide scale and is the main indicator for measuring a nation's state of the economy. It is used to compare national economies against each other. Recently, individual countries and international organisations (EU, World Bank etc.) have moved away from focussing only on GDP as a measure of well-being.

III. Data	
g. How is the underlying data gathered and by whom?	Data are gathered by national statistical offices and reported to international organizations. In the EU, Eurostat estimates the aggregate for the EU and the euro area; all other data are produced by the statistical offices of the respective Member States. Eurostat states that "[t]he coverage for national data varies from country to country, partly due to derogations provided for in the transmission and back-projection programme, and can, in some cases, be substantially longer than for the European aggregates" (Eurostat, 2009).
h. How accurate are the results (e.g. is the result an estimate, are there data gaps, imputations, assumptions, etc)?	In general, the published results are "accurate enough to meet the user demand for current data" (German Statistical Office, no date). However, often the published data are preliminary data, which might have to updates several times in order to take account of new statistical information. Therefore, initial results can differ from the final results. In Germany, final results are only published after about four years, while preliminary and final results differ by about 0.5 percentage points based on a multi-annual comparison (German Statistical Office, no date). Even the final dataset may contain data gaps and imputations.
i. How often is the indicator recalculated/released? Have there already been any major indicator revisions?	At Eurostat, the accounting period is the calendar year (Eurostat, 2009). Coverage differs among the Member States. Germany, for instance, calculates GDP on an annual and on a quarterly basis. The annual figure is published in mid-January of the subsequent year; the quarterly figure about 45 days after the end of the quarter (German Statistical Office, no date).
IV. Link to sustainable development	
j. Is there an operational definition of sustainability 'built-in' to the methodology?	There is no operational definition of sustainability 'built-in' to GDP. However, GDP can be expressed in ways, which provide a more balanced picture of the state of the economy. For instance, GDP can be expressed on a per-household basis, thereby taking account of distributional aspects. Moreover, GDP can be applied to portray the resource and carbon intensity of an economy.
k. If yes, does the indicator measure 'strong' or 'weak' sustainability?	GDP does not measure 'strong' nor 'weak' sustainability, as there is no operational definition of sustainability 'built-in' to the indicator.
l. Does the approach have numerical value(s) assigned to sustainability (e.g. a thresholds/ irreversabilities below which a region/activity is not sustainable)?	GDP does not have numerical values assigned to sustainability, as there is no operational definition of sustainability 'built-in' to the indicator.
m. Please describe the key methodological links to highly related indicators (what exactly are the commonalities and differences among these indicators)?	As the discussion about 'Green GDP' shows, there are approaches to link the indicator to sustainable development. Furthermore, there are a number of specific sustainable developments indicators, which are based on frameworks similar to the NAS, for instance the System of Integrated Environmental and Economic Accounting (SEEA) and Adjusted Net Savings (ANS) / Genuine Savings (GS).
n. What are the key "bridging" links to other dimensions of sustainability (environmental, social, economic) and are there any explicit hybrid measures incorporating multiple dimensions in a single metric (e.g. GHG intensity—GHG emissions per unit of GDP).	GDP as an economic indicators links to the social dimension of sustainability with its connection to unemployment, which is expressed in Okun's Law. In the early 1960s, economist Arthur Okun began to describe an empirical, linear relationship between GDP growth and unemployment; lower GDP growth correlated with higher unemployment and robust GDP growth with low unemployment (Knotek, 2007). According to Freeman (2000), every two percent change in GDP roughly corresponds to a one point change in unemployment. However, this equation is highly dependent on the country under investigation. The relationship between GDP and unemployment is not a direct cause and effect relationship per se, but rather arises from a variety of different factors in the economy. Although termed an economic law, Knotek (2007) points out that "[i]n reality, though, Okun's law is a statistical relationship rather than a structural feature of the economy." Links to the environmental dimension of sustainability can be established by integrating, for instance, measures of greenhouse gas emissions or resource

	uses with GDP. This hybrid measure informs about the intensity of negative environmental impacts in relation to economic activity.
V. Institutional Analysis	
o. Which institutions are currently using the indicator, and for which purposes?	GDP is currently the standard measurement for a country's or a region's economic performance. It is used by national statistical offices around the world. They report their data to international organizations, which calculate regional or global GDP aggregates. Among the intergovernmental institutions, which use GDP to compare countries' economic performances against each other are the UN, World Bank, OECD and the EU.
p. What are the driving forces and characteristics that affect institutional adoption (consider this question from the perspectives of political science, sociology and political economy)?	The high degree of institutional adoption of GDP relates to the indicator's ability to inform policy-makers, economic planners and businesses to monitor the state of the national economy and to assess "the impact of different tax and spending plans, the impact of oil and other price shocks, and the impact of monetary policy on the economy as a whole and on specific components of final demand, incomes, industries, and regions" (Bureau of Economic Analysis, 2000). GDP presents the data in an organized way, so that they can be used as a basis for political decisions.
q. Are there links to international or European laws, conventions or agreements (this could range from an explicit legal requirement to a general policy concern)?	In the EU, GDP is considered the most important structural indicator. The EU's Lisbon Strategy for economic, social and environmental renewal targets an annual GDP growth of 3%.
VI. RACER Analysis	
Criteria and Sub-criteria	**Analysis**
Relevant	
POLICY SUPPORT	+ GDP provides a consistent methodological framework for measuring the state of national economies. + GDP is used as the main structural indicators in most of the world's countries and accordingly in intergovernmental organisation. + GDP is considered the most important structural indicator in the EU and achieving 3% GDP growth is an explicit policy target mentioned in the EU's Lisbon Strategy. – Recently, a global movement among governments and policy-makers towards alternative well-being measures is observable, especially to those which also take sustainability aspects into account.
IDENTIFICATION OF TRENDS	+ GDP provides policy-makers, economic planners and business with clear indications of the overall state and trend of the economy. + GDP allows tracking trends over time and cross-sectorally in flows. – GDP does allow tracking trends in some stocks, such as minerals and fossil materials, but not in built capital.
FORECASTING AND MODELLING	+ GDP data are the main input for economic scenarios. + Analysts can deduce from (forecasted) trends in GDP growth how other indicators, such as employment, may behave. – Economic shocks cannot be predicted with certainty, so that forecasts are always subject to uncertainty.
SCOPE/LEVELS OF APPLICATION	+ GDP is applied as the main structural indicator in countries around the world. Data are calculated on a local, national, regional and international level.
Accepted	
STAKEHOLDER ACCEPTANCE	+ GDP is accepted as the most important structural indicator by economic planners and policy-makers world-wide. – Its failure to take sustainability aspects into account has recently led to an

	interest in alternative welfare indicators among the policy community. – Among scientists (sociologists and economists) alternative well-being indicators gain more and more acceptance, as GDP is increasingly regarded as an inappropriate measure of welfare – For the public, it is often difficult to see the relevance of GDP data in their daily lives.
Credible	
UNAMBIGUOUS	+ Unambiguous due to clearly defined parameters and results.
TRANSPARENCY OF THE METHOD	+ Calculation of the indicator is standardised, thus it can be regarded as one of the most transparent indicators.
Easy	
DATA AVAILABILITY	+ Data are collected by national statistical offices and are usually sufficiently available.
TECHNICAL FEASIBILITY	+ Data collection is resource intensive. Once the monitoring and reporting system is established, data processing is a relatively simple task.
COMPLEMENTARITY AND INTEGRATION	± GDP can be monitored and analysed in relation to other dimensions, such as natural and human capital (cf. the System of Integrated Environmental and Economic Accounting (SEEA) and Adjusted Net Savings (ANS) / Genuine Savings (GS)).
Robust	
DEFENSIBLE THEORY	+ Based on a sound accounting methodology backed by most national and international institutions.
SENSITIVITY	+ There is a high data density. + Data are produced on an annual or even quarterly basis. + Some components (economic sectors) may dominate the indicator, which may result in fluctuations of the indicator. – Final data may only be published after an extended period of time.
DATA QUALITY	– The data collection system is usually developed. However, countries differ in the frequency of data reported.
RELIABILITY	+ Coherent, consistent framework that yields reliable information on the state of the economy. – According to a growing number of sceptics, GDP does not inform about true welfare.
COMPLETENESS	– GDP does not directly take into account sustainability aspects, such as effects of production on the environments or the distribution of welfare among the population.
Summary appraisal	The fact that GDP is a worldwide recognised and established indicator gives it a relative advantage over new, alternative indicators. It is highly accepted among policy-makers and the scientific community. Its credibility and robustness relates to the sufficient availability of data. Its completeness, however, is curtailed due to the fact that GDP does not directly take sustainability aspects into account.
VII. Supplemental RACER policy analysis	
Policy Target	**Does the indicator reflect this target?**

CLIMATE CHANGE AND CLEAN ENERGY	GDP does not reflect climate change and clean energy as a policy target.
SUSTAINABLE TRANSPORT	GDP does not reflect sustainable transport as a policy target.
SUSTAINABLE CONSUMPTION AND PRODUCTION	GDP does not reflect sustainable consumption and production as a policy target.
CONSERVATION AND MANAGEMENT OF NATURAL RESOURCES	GDP does not reflect conservation and management of natural resources as a policy target.
PUBLIC HEALTH	GDP does not reflect public health as a policy target.
SOCIAL INCLUSION, DEMOGRAPHY, AND MIGRATION	GDP does not reflect social inclusion, demography, and migration as a policy target.
GLOBAL POVERTY AND SUSTAINABLE DEVELOPMENT CHALLENGES	GDP does not reflect global poverty and sustainable development challenges as a policy target.
INVESTMENT IN RESEARCH AND DEVELOPMENT	Investment in research and development is captured within the general accounting framework. It is not identified as an explicit target, but can be identified from the collected data (conversion of money into goods and services).
UNEMPLOYMENT RATE	GDP does not directly reflect the unemployment rate as a policy target. One could, however, apply Okun's Law (Knotek, 2007) to deduce an impact from a change in economic growth on the employment rate, but should not assume a distinct cause-effect relationship (Freeman, 2000).
r. How does the indicator help measure progress toward the policy targets (marked 'Yes' and 'Partially, above)? What are the advantages of using this indicator?	GDP on its own does not help measure progress of any policy target related to sustainability. The indicator, can however, be combined with other indicators to portray the sustainable performance of an economy.
s. What are the most important pitfalls of using this indicator as a measure of progress to the policy targets (marked 'Yes' and 'Somewhat', above)?	GDP on its own does not help measure progress of any policy target related to sustainability.
VIII. Potential Links with Other Indicators (further detail to be collected in the 'basket analysis')	
t. What other indicators could be combined in a basket with the one in question to address specific policy challenges relevant to the EU policy framework?	In theory, all other mainstream economic and sustainable development indicators could be analysed in relation to GDP. Especially the policy target of decoupling economic growth from pollution (waste and emission) and resource use can be monitored in such a way. Especially close links exist to the System of Integrated Environmental and Economic Accounting (SEEA) and Adjusted Net Savings (ANS) / Genuine Savings (GS), which are based on frameworks similar to the national accounts system (NAS).
V. SWOT Analysis	
*u. Core strengths (*Core strengths are the strongest aspects and main advantages of the indicator that may be unique to the	GDP is used on a world-wide scale and is supported by all major institutions. Its calculation based on a standardized methodological framework, which makes GDP figures comparable among countries and regions. GDP measures economic growth, which is still regarded as the prerequisite for prosperity and well-being by a large share of the stakeholders (policy-makers, scientists, the

indicator in question.)	public).
v. *Important strengths (*Important strengths are those strengths that are highly significant but that may be shared with a host of other indicators.)	Accounting frameworks are implemented in most countries around the world. Thus, GDP figures can be generated at no additional costs, while alternative indicators often lack a sound data basis.
w. *Critical weaknesses* (Critical weaknesses are any weaknesses that may preclude implementing the indicator at an EU level. Unless a critical weakness is fixed, it is inadvisable or impractical to use the indicator at the national or EU level.)	GDP is incorporated in the core set of structural indicators at national and EU level. From that, one can conclude that no critical weakness has been observed so far.
x. *Important weaknesses* (Important weaknesses, in contrast, limit the usefulness of the indicator in question but do not wholly prevent the indicator from being implemented as an EU policy tool.)	There is a growing consensus that GDP does not measure true well-being, as it does not take account of sustainability aspects. This has also been recognized by policy-makers at the EU level and led to initiatives, which aim at developing alternative indicators, which can be used supplementary to GDP. Although these important weaknesses have been recognized, official statements show that GDP is likely to remain the most important structural indicator in the future.
y. *Opportunities* (This category of the SWOT analysis lists the most important opportunities that could help improve the indicator or that could help guide successful implementation of the indicator.)	The increasing importance of sustainability aspects in the public debate might offer the opportunity for an adjustment of the indicator. Adjustments could take account of the sustainability of economic growth, the externalities generated by economic growth, and welfare distribution. Moreover, GDP could be calculated on per-household basis as suggested by Stiglitz, Sen and Fitoussi (2009b) rather than on a per-capita basis.
z. *Threats* ('Threats' are institutional, political, intellectual, and technological environments that could most likely act as barriers in the future to successful adoption of the indicator.)	The movement "beyond GDP" may eventually lead to the development of alternative wellbeing- indicators. This movement is observable among both scientists and policy-makers. However, GDP will most likely remain the premier structural indicator in the future, while additional indicators might serve as a supplement.

4.2 SEEA Framework

The SEEA-2003 does not provide indicators for whether a country's economic activity is sustainable or not (and may therefore not realize its full potential) but is a comprehensive accounting system for tracking environmental and economic capital, rents, and expenditures. The revised SEEA (2010) can bring consistency, coherence, and wider cross-applications to environmental accounting. The accounting system does not engage in debates over environmental accounting, and therefore does not give the end user much guidance in determining whether a country is either weakly or strongly sustainable. A growing number of

countries, primarily those in the OECD and countries endowed with environmental resources use the SEEA to compile environmental accounts in varied format and completeness.

III. Indicator Summary	
Name of indicator	System of Integrated Environmental and Economic Accounting (SEEA), 2003 version
Indicator category	Economic
IV. Background information on the indicator	
a. What is the official definition of the indicator?	The SEEA-2003 (United Nations, 2003) is an international coherent and comprehensive accounting framework for measuring objectively and consistently how environmental functions contribute to the economy and how the economy exerts pressures on the environment (Pedersen and de Haan, 2006). It is not a sustainable development indicator or set of indicators, although it is possible to derive indicators of mostly weak sustainability from the SEEA, e.g., environmentally adjusted Net National Product (eaNNP), Genuine Savings (GS, aka ANS), and Index of Sustainable Economic Welfare (ISEW) (Dietz and Neumayer, 2007).
b. Unit(s) of measurement of the indicator	Physical and monetary; Indicators derived from SEEA accounts are measured in physical, monetary, or dimensionless units (fractions, percentages).
c. What does the indicator seek to measure?	The SEEA measures the contributions of the environment to economic activity and the pressures of the economy on the environment in an integrated accounting framework closely linked to the international standard of economic accounting, i.e., the System of National Accounts (United Nations, 1993a). The SNA fails to account for negative consequences of economic activity through pollution emissions (Smith, 2007).
d. Provide a brief history of the indicator. Which organization or body originally proposed the indicator (and in what year)? Which organizations currently advocate for the indicator's use?	The SEEA has its roots in the System of National Accounts (SNA), which grew out of post-WWII reconstruction efforts including the Marshall Plan. In developing the SNA, the United Nations and collaborating agencies established a standard method for keeping track of economic activity and growth but failed to include the environment and natural resource depletion as major aspects of this accounting system (Smith, 2007). As the concepts of environmental protection and sustainable development became increasingly prominent, the shortfalls of the SNA also became apparent (Lange, 2007). For example, while SNA records the income from harvesting forests or extracting minerals, it does not account for the corresponding loss of natural capital (Lange, 2007). In 1993, the United Nations Statistics Division developed the first (interim) international handbook for environmental accounting. This publication, entitled the *Handbook of National Accounting: Integrated Environmental and Economic Accounting* is known as SEEA-1993 (Smith, 2007). Lange (2007) reports that, by 2000, SEEA-1993 had become the leading approach to environmental accounting, used in several developed and a few developing countries. A revision was commissioned by the UN Statistical Commission, which was finalized in 2003 and is known as the SEEA-2003. The UN Statistical Commission in 2005 requested the 2nd revision of the SEEA by 2010 to be elevated to an International Statistical Standard. The UNCEEA (UN Committee on Environmental-Economic Environmental Accounting) was tasked with the revision with the cooperation of the London Group and other key players in environmental accounting (UNSD, 2009).
e. What are the known limitations of the indicator?	The SEEA-2003 has the following key limitations: • The valuation of environmental resources, depletion, and degradation depends on normative values, discount rates chosen, and methods to determine prices (e.g., willingness to pay, shadow prices, etc.). • The SEEA-2003 does not endorse or provide clear guidance on valuation, accounting, and modeling techniques necessary to

	monetarize environmental resources and services. Where methodological or philosophical controversy remains among national accountants, statisticians, and others involved in environmental accounting, the SEEA attempts to highlight those issues and presents different approaches to solving them (it could also be argued that this approach is a reflection of the SEEA's objectivity). • The SEEA-2003 makes references to sustainable development but remains vague on its operational definition and does not promote actual sustainability indicators (or evaluates their utility with respect to the selected sustainability definition). SEEA-2003 suggests indicators 'warning of threats to sustainability' but does not measure sustainability (Bartelmus, 2007) • The SEEA-2003 vaguely favors a 'capital maintenance' approach to sustainability which it then links to a micro-economic Hicksian income concept. Bartelmus (2007) points out that Hicks and national accountants have shown that micro-economic Hicksian income "… cannot be aggregated and is incompatible with the 'net worth' definition of wealth in the national accounts." • The aggregation of items based on mass units as opposed to monetary units is also controversial because of their different environmental impacts (e.g., a ton of wood wastes from a timber mill does not have the same environmental impacts as a ton of mining wastes). • The SEEA-2003 is very data intensive, although the modular set-up means that the entire SEEA does not need to be implemented. • The SEEA-2003 does not capture other sustainability concepts such as 'resilience' or 'vulnerability', nor does it represent the emerging field of accounting for ecosystems (Heal, 2007)
f. What is the history and status of the methodological development and adoption of the indicator (e.g. major revisions, current efforts, future plans/initiatives)?	The SEEA grew out of SNA and the first handbook was published in 1993. The SEEA-2003 revision provides a full set of accounts with 4 types: physical and hybrid flow accounts, environmental protection and management accounts, asset accounts, and environmentally modified macro-aggregates. The revision currently under way with the goal to be completed by 2010 is planned to be elevated to an international statistical standard by the UN Statistical Commission.
III. Data	
g. How is the underlying data gathered and by whom?	Because of the close linkage to the SNA, the SEEA-2003 data are primarily collected by national statistical agencies (account sections) through surveys, registers, and other means. Sub-national as well as international environmental accounts are also possible with the necessary data being collected by appropriate agencies or drawn from national environmental accounts.
h. How accurate are the results (e.g. is the result an estimate, are there data gaps, imputations, assumptions, etc)?	The accuracy of the SEEA-2003 depends on the following issues: • The quality and comprehensiveness of the collected data. The accounting framework itself ensures a high degree of consistency, coherence, and completeness (if implemented fully). • The extent and methods used to impute missing data, e.g., as residual in an accounting identity, or via known or estimated associations, or via proxies such as average resource extraction costs for marginal extraction costs. • The extent and validity of the assumptions required, e.g., for converting physical accounts to be monetary.
i. How often is the indicator recalculated/released? Have there already been any major indicator revisions?	The SEEA-2003 is not fully implemented in any country. Many countries now use some form of environmental resource accounts (usually in physical terms). The frequency of updates may vary but is usually annual. The initial SEEA 1993 was revised as SEEA-2003 and a second revision under the auspices of the UNCEEA is underway and expected to be finalized in 2010.
IV. Link to sustainable development	
j. Is there an operational definition of sustainability 'built-in' to the methodology?	The SEEA-2003, while referring to the need for and paradigm of sustainable development, does not itself provide an operationalized definition and only suggested some indicators for measuring it.

k. If yes, does the indicator measure 'strong' or 'weak' sustainability?	The capital maintenance approach, which is vaguely favoured in the SEEA-2003 would give rise to a weak sustainability paradigm but in principle many different sustainability indicators can be calculated on the basis of SEEA accounts.
l. Does the approach have numerical value(s) assigned to sustainability (e.g. a thresholds/ irreversabilities below which a region/activity is not sustainable)?	The availability of sustainability values or thresholds depends on the choice of indicator(s) calculated. For example, environmentally adjusted Net National Product (eaNNP, calculated as GNP-Dp-Dn where GNP is Gross National Product, Dp is depreciation of produced capital, and Dn is depreciation of natural capital) would be required to be at a minimum non-negative, but other indicators such as Total Material Requirements (TMR) do not have a pre-specified sustainability value or threshold.
m. Please describe the key methodological links to highly related indicators (what exactly are the commonalities and differences among these indicators)?	The SEEA-2003's close link to the SNA means that SEEA-based indicators are based on the consistent definitions and classifications of the SNA (e.g., with respect to industry and product classifications). The SEEA-2003 derived indicators such as eaNNP or 'green' GDP are linked to main economic aggregates such as NNP or GDP via explicit accounting identities.
n. What are the key "bridging" links to other dimensions of sustainability (environmental, social, economic) and are there any explicit hybrid measures incorporating multiple dimensions in a single metric (e.g. GHG intensity—GHG emissions per unit of GDP).	The SEEA-2003's primary value lies in the bridging of the economic and environmental spheres, recognizing the environment as a critical input to economic activities and recipient of residuals of economic production. The SEEA-2003 is a tool for environmental-economic management and the indicators that can be derived from the accounts link economic and environmental aspects. The social dimension of SD is not reflected in the SEEA-2003.
V. Institutional Analysis	
o. Which institutions are currently using the indicator, and for which purposes?	Leading institutions in the promotion and development of the SEEA-2003 are the UN, World Bank, IMF, CEC, and OECD. National users include the statistical offices in many countries, primarily industrialized countries such as NOR, NLD, DEU, JPN, DNK, AUS, NZL, CAN; some developing countries such as the PHL and IDN have built some satellite accounts for important environmental resources.
p. What are the driving forces and characteristics that affect institutional adoption (consider this question from the perspectives of political science, sociology and political economy)?	The main barrier to adoption of the SEEA-2003 is the substantial investment in resources (people, knowledge, data) required to develop even a subset of the SEEA accounts as well as conceptual disagreements among accountants, environmental economists, and others involved in the measurement of sustainability. The accounts per se also do not lend themselves to environmental policy-making; indicators need to be calculated from the accounts to convey key messages to decision-makers. This has not been emphasized in the past and the SEEA's neutral stand on controversial methodological issues has also hampered wide implementation of the system. Many countries are also hesitant to change their national accounting systems.
q. Are there links to international or European laws, conventions or agreements (this could range from an explicit legal requirement to a general policy concern)?	Links to international or European laws, conventions, or agreements include: • The 1992 Rio Summit, which calls for development of sustainable development indicators and environmental accounting (the latter is not part of 2002 Johannesburg Plan of Action though). • The SNA link and adherence to national accounting norms and standards. • The prospect of becoming an international statistical standard. • The de-facto EU-wide application of NAMEA (National Accounting Matrix with Environmental Accounts developed in The Netherlands).
VI. RACER Analysis	

Criteria and Sub-criteria	Analysis
Relevant	
POLICY SUPPORT	+ SEEA-2003 provides consistent methodological framework for measuring and tracking economy-environment interactions and is linked to the widely implemented SNA. + SEEA has been developed with substantial European involvement (EUROSTAT and members of the London Group). + NAMEA accounts were developed in The Netherlands and are a blue-print for physical flow accounts in SEEA-2003 and NAMEA implementation has also been actively promoted and supported by EUROSTAT. – SEEA-2003 does not endorse a single methodology to value environmental goods, services, and degradation. – SEEA-2003 only suggests some indicators for measuring 'threats to sustainability'. – While a number of indicators linked to sustainability can be calculated from the SEEA-2003, they by and large (a) measure weak sustainability and (b) only reflect necessary and not sufficient conditions for sustainability.
IDENTIFICATION OF TRENDS	+ Accounting framework of SEEA-2003 allows tracking trends over time and cross-sectorally in stocks and flows. + Can reflect changes in behaviour and environmental expenditures and taxation over time. – Certainty of such trends depends on data quality and completeness of the accounts.
FORECASTING AND MODELLING	+ SEEA-2003 itself does not engage in modelling but discusses ways to use the accounts to perform economic and environmental modelling and has been used in econometric equilibrium models. + Consistency of data and definitions makes cross-temporal and cross-sectoral comparisons possible. – Strong assumptions may need to be made in the modelling, e.g., when predicting prices into the future.
SCOPE/LEVELS OF APPLICATION	+ Can be applied at international, regional, national, and sub-national level.
Accepted	
STAKEHOLDER ACCEPTANCE	+ Sound methodology and linkage to the SNA means the SEEA-2003 has found a growing following among national accountants, statisticians, environmental economists, researchers, and practitioners. + Supported by UN Statistical Commission, London Group members, WB, IMF, OECD, and CEC. – Acceptance by policy-makers more limited and hesitantly because of high degree of technical expertise required to understand the methodological foundations and because the SEEA publications did not take a guiding role in the measurement of sustainability and did not provide a single, well-defined set of sustainability indicators. – Limited data and resource intensive, controversial valuation methods and assumptions, link to sustainability not clear enough. – Countries hesitant to change their national accounting systems.
Credible	
UNAMBIGUOUS	± Less ambiguous than many loosely organised sets of indicators but no operationalised definition of sustainability. – Different valuation methods may lead to very different conclusions about sustainability of economy.
TRANSPARENCY OF THE METHOD	+ Calculations clearly explained. – Requires substantial knowledge of national accounting and environmental resources.

Easy	
DATA AVAILABILITY	+ Builds and expands on SNA and corrects its main failures, so data collection can be tied to national accounts data collection. + Not all accounts need to be implemented to reap the benefits of the SEEA-2003, countries can decide according to their needs. – Overall, very data intensive and in many developed and developing countries not all data even for selected accounts are available.
TECHNICAL FEASIBILITY	± Resource intensive but designed for widespread application in broad range of circumstances.
COMPLEMENTARITY AND INTEGRATION	+ High potential for integration and complementarity given the link to the SNA. – Implementation must consider policy relevance and use, without it, it is only costly and not useful.
Robust	
DEFENSIBLE THEORY	+ Based on sound accounting theory backed by many international and national institutions. – SEEA does not provide guidance in choosing one method of valuation over another.
SENSITIVITY	+ Yes if data density is high enough and accounts (or indicators derived from them) are updated often enough (at least annually) – Big items may dominate smaller but important ones, e.g., oil in Norway dominates other resources
DATA QUALITY	± Depends on completeness and quality of collection system, e.g., developing countries struggling to deliver complete and accurate SNA accounts will find the SEEA-2003 difficult to implement, while countries with long experience in the design and use of natural resource accounts such as The Netherlands, Canada, and Germany produce high quality accounts. On the other hand, no country has and needs to implement all SEEA-2003 accounts but should focus on its high priority natural assets. – Subjective decisions and assumptions may be hidden in neutral-looking aggregate indicators
RELIABILITY	+ Coherent, consistent framework that yields reliable information on economy-environment interactions if the data are of sufficient quality – Different indicators or the same indicator calculated from SEEA-2003 with different methods may send different signals (e.g., different discount rates, different marginal cost)
COMPLETENESS	+ SEEA-2003 is comprehensive framework for describing and explaining economy-environment interactions and better integrating the environment into the economic sphere. + Modular form of the SEEA-2003 means that each country can focus on the implementation of the high priority natural assets (physical and monetary) and thereby be comprehensive without having to use the full set of SEEA-2003 accounts.
Summary appraisal	The SEEA-2003 does not provide indicators for whether a country's economic activity is sustainable or not (and may therefore not realize its full potential) but is a comprehensive accounting system for tracking environmental and economic capital, rents, and expenditures. The revised SEEA (2010) can bring consistency, coherence, and wider cross-applications to environmental accounting. The accounting system does not engage in debates over environmental accounting, and therefore does not give the end user much guidance in determining whether a country is either weakly or strongly sustainable.
VII. Supplemental RACER policy analysis	

Policy Target	Does the indicator reflect this target?
CLIMATE CHANGE AND CLEAN ENERGY	The SEEA-2003 can be used to examine contributions to climate change and use of clean energy.
SUSTAINABLE TRANSPORT	The SEEA-2003 is better suited than other indicator systems for measuring sustainable transport because it allocates transport emissions to the producer and not to the point of origin, i.e., all international transport is allocated to the country and its resident units that undertake it. Sustainability criteria need to be defined though.
SUSTAINABLE CONSUMPTION AND PRODUCTION	Sustainable consumption and production can be measured because the SEEA-2003 allows calculation of total consumption and accounts for all environmental inputs, environmental resources, and wastes used and generated for. Sustainability criteria need to be defined though.
CONSERVATION AND MANAGEMENT OF NATURAL RESOURCES	The conservation and management of natural resources is a primary purpose of the SEEA-2003.
PUBLIC HEALTH	Public health aspect can be captured indirectly through accounting of harmful substances and pollution emissions but no public health profiles or exposure or dose-response data are collected.
SOCIAL INCLUSION, DEMOGRAPHY, AND MIGRATION	Social inclusion, demography, and migration are not directly measured in the SEEA-2003, although these dimensions could be added and exist in part via the link to the SNA.
GLOBAL POVERTY AND SUSTAINABLE DEVELOPMENT CHALLENGES	The SEEA-2003 does not measure per capita poverty as conventionally defined (static poverty threshold or relative income measure) but allows the measurement of national and global wealth.
INVESTMENT IN RESEARCH AND DEVELOPMENT	Investment in research and development is not directly measured in the SEEA-2003 but is captured in the SNA.
UNEMPLOYMENT RATE	The unemployment rate is not directly measured in the SEEA-2003 but can be calculated from the SNA.
r. How does the indicator help measure progress toward the policy targets (marked 'Yes' and 'Partially, above)? What are the advantages of using this indicator?	The SEEA-2003 framework offers consistent framework for tracking economy-environment interactions and follows standard accounting principles. Its direct link to the SNA is appealing for defining and tracking indicators aimed at environmental sustainability. The number of indicators that can be generated should the available data allow it is nearly endless.
s. What are the most important pitfalls of using this indicator as a measure of progress to the policy targets (marked 'Yes' and 'Somewhat', above)?	The most controversial issue in the SEEA-2003 is the valuation of natural assets and services. Also, the capital maintenance approach favoured by the SEEA-2003 still requires decisions regarding weak or strong sustainability paradigms and hence affects if and how sustainability indicators would be calculated.
VIII. Potential Links with Other Indicators (further detail to be collected in the 'basket analysis')	
t. What other indicators could be combined in a basket with the one in question to address specific policy challenges relevant to the EU policy framework?	Possible complementary indicators to those that can be calculated from the SEEA-2003 include biophysical measures such as EF, ecosystem accounts (for strong sustainability), social indicators such as social and human capital, and ecological indicators such as ecological resilience.
V. SWOT Analysis	

u. *Core strengths (*Core strengths are the strongest aspects and main advantages of the indicator that may be unique to the indicator in question.)	• The SEEA-2003 methodology makes more apparent the rationale for sustainable development. It guides economic ministries to calculate not only the cost of natural resource extraction but also increases in savings achieved by reinvesting this rent in wealth-generating capital (Auty, 2007). It also provides a system for determining the amount of resource rent that is retained through taxes and quantifies any loss of resource rents to excess corporate profits or inefficient labour and labour contracts (Auty, 2007). • The SEEA-2003 brings a high level of coherence to economic and environmental data. This includes both internal and external coherence: the ability to compare quantities within a particular topic as well as the ability to compare quantities from diverse economic and environmental areas (Smith, 2007). Lange (2007) explains, "The SEEA is especially important for economic modellers, who often must put great effort into making environmental statistics consistent with the input-output tables at the core of their models. The SEEA offers environmental statistics that are compiled in a manner that is consistent with IO tables, hence eliminating the need for that data work by modellers." The SEEA-2003 not only puts economic and environmental data on a comparable playing field but also eliminates much superfluous work in making statistics comparable. Additionally, because of the close link between SNA and SEEA-2003, environmental data compiled with SEEA-2003 methodology is immediately coherent with a wide variety of economic measures and statistics (Smith, 2007).
v. *Important strengths (*Important strengths are those strengths that are highly significant but that may be shared with a host of other indicators.)	• The SEEA-2003 gives focus and direction to data collection. It provides guidelines on what kind of data to collect, how to collect it, and how to report the data. The accounting system helps to ensure that end users receive the information they need and those collecting data do not spend time and money collecting unneeded information (Smith, 2007). • The SEEA-2003 promotes comprehensiveness in environmental accounting, if nothing else, by factor of the comprehensiveness and thoroughness of SEEA itself. Smith (2007) explains that, over many years, SNA has brought a new level of consistency and comprehensiveness to economic accounting; he argues that SEEA promises the same. SEEA similarly emphasizes the need for consistency in economic accounting (Smith, 2007). • The SEEA-2003 framework, if implemented widely and to a high extent, would allow the aggregation of data from local to national, regional, and international level.
w. *Critical weaknesses* (Critical weaknesses are any weaknesses that may preclude implementing the indicator at an EU level. Unless a critical weakness is fixed, it is inadvisable or impractical to use the indicator at the national or EU level.)	• The only critical weakness of the SEEA-2003 might be that over several decades of work no consensus has emerged on the valuation of environmental goods and services and that hence expression of damages and depletion in monetary values remains fraught with assumptions and normative standpoints.
x. *Important weaknesses* (Important weaknesses, in contrast, limit the usefulness of the indicator in question but do not wholly prevent the indicator from being implemented as an EU policy tool.)	• The SEEA-2003 may overlook the weakening or collapse of some natural and biological resources, suggesting that the SEEA-2003 may not be sufficiently comprehensive. Walker and Pearson (2007) point out that the SEEA-2003 does not measure underlying ecosystem variables that may, to a large part, determine the resilience and supply of valued natural resource stocks. As a consequence, the SEEA-2003 may miss conservation priorities and may overvalue natural resource stocks. • The aversion of the SEEA-2003 framework to controversy may also limit the applications of the accounting system. First, the SEEA-2003 often declines to cost environmental impacts because pricing these impacts is a subject of modeling, not the strict descriptive accounting to which the SEEA-2003 is tasked (3). Additionally, the SEEA-2003 does not systematically provide guidance in differentiating between

	weak and strong sustainability. Dietz and Neumayer (2007) explain that the SEEA-2003 begins with a discussion of sustainability but drops this distinction further in the text and fails to provide real, aggregate measures of both weak and strong sustainability. Additionally, when there are differing methods for weak versus strong sustainability, the SEEA-2003 simply presents each method side by side without providing any guidance or recommendations for which method may be more appropriate (Dietz and Neumayer, 2007).
y. Opportunities (This category of the SWOT analysis lists the most important opportunities that could help improve the indicator or that could help guide successful implementation of the indicator.)	• The SEEA-2003 has the institutional support and technical expertise of the UN, WB, IMF, EU, OECD, and several – mostly developed – countries. The agencies involved in the development of the SEEA and primarily the London Group have a proven track record of supporting and improving the accounting framework. This history and level of support would facilitate wider adoption of SEEA.
z. Threats ('Threats' are institutional, political, intellectual, and technological environments that could most likely act as barriers in the future to successful adoption of the indicator.)	• Adoption of the SEEA-2003 implies fundamental changes to a country's entire system of economic and environmental accounting which could be costly or could meet opposition because of the scale of the accounting change. • More focus should be given to developing indicators from the SEEA-2003 that have immediate and high policy relevance to amplify the utility of the SEEA.

4.3 Adjusted Net Savings (Genuine Savings)

Adjusted Net Savings (ANS) adds the notion of capital to standard GDP measures. Since the World Bank adopted the ANS indicator in 1999, its geographical coverage has steadily increased and now covers more than 130 economies annually. Still, the limitations in data availability and quality still hamper the calculation of this indicator but it is gaining traction among policymakers. A major shortcoming is that the underlying concept of sustainability is weak sustainability and that there is no exhaustive accounting of natural resource depletion and degradation (missing are, for example, water resources, fisheries, soils, and biodiversity).

V. Indicator Summary	
Name of indicator	Adjusted Net Savings (ANS) / Genuine Savings (GS)
Indicator category	Economic
VI. Background information on the indicator	
a. What is the official definition of the indicator?	ANS (GS) measures the true rate of savings in an economy after taking into account investments in human capital, depletion of natural resources and damage caused by pollution (World Bank, 2009). <u>Formula:</u> GROSS NATIONAL SAVING - CONSUMPTION of fixed capital = NET NATIONAL SAVING + Education expenditure (investment in human capital)

	- Energy depletion - Mineral depletion - Net forest depletion - Damage from CO2 emissions - Damage from PM emissions (optional) = ADJUSTED NET SAVING
b. Unit(s) of measurement of the indicator	ANS is measured as percent of GNI or in monetary units.
c. What does the indicator seek to measure?	The ANS aims to be a measure of the sustainability of investment policies by measuring changes in wealth during a specified accounting period. In particular, it allows to test whether rents from natural resources and changes human capital are balanced by net saving in man-made capital. ANS expands the notion of 'assets' by including natural resources and human capital (Bolt et al., 2002).
d. Provide a brief history of the indicator. Which organization or body originally proposed the indicator (and in what year)? Which organizations currently advocate for the indicator's use?	The first application of accounting methods designed to augment the concepts of savings and investment by expanding assets to include natural and human capital was by Pearce and Atkinson (1993) for 20 countries. The analysis indicated that many countries are on unsustainable path because GROSS SAVINGS was less than combined conventional CAPITAL DEPRECIATION and NATURAL RESOURCE DEPLETION. Their modified index is known as GENUINE SAVINGS, now referred to as ADJUSTED NET SAVINGS. The World Bank began formally using the index in 1997 and first incorporated ANS into its *World Development Indicators* publication in 1999 (Ferreira and Vincent, 2005). Hamilton (2000) in the theoretical motivation for ANS (GS) explains, „Given the centrality of savings and investment in economic theory, it is perhaps surprising that the effects of depleting natural resources and the environment have not, until recently, been considered in the measurement of national saving." The World Bank published the indicator annually for nearly all economies worldwide.
e. What are the known limitations of the indicator?	The key limitations of ANS are: • The underlying concept of sustainability is weak sustainability. • The addition of education expenditures to savings assumes that $1 in expenditures equals $1 in human capital. • Private education expenditure is not included in ANS. • There is no exhaustive accounting of natural resource depletion and degradation (missing are, for example, water resources, fisheries, soils, and biodiversity). • The accounting of net forest depletion includes only timber but not non-timber benefits provided by standing forests (e.g., soil protection, mineral cycling, biodiversity). • The accounting of natural resource depletion and degradation suffers from same problems of other accounting-based sustainability indicators, incl. calculation of resource rents as difference between market value of extracted resource and average extraction cost instead of marginal cost. • Missing data on prices, extraction costs, amounts of resources extracted, education expenditures, etc. require imputation and hence frequently untestable assumptions. • Population growth not factored into the relationship that current changes in ANS equate to net present value of changes in future consumption. • ANS does not reflect technological changes. • ANS does not address the problem of how to treat transboundary damages. Sources: Bolt et al. (2002), UNDSD (2007), Hamilton (2000).
f. What is the history and status of the methodological development and adoption of the indicator (e.g. major revisions, current efforts, future plans/initiatives)?	The GS indicator was first proposed by Pearce and Atkinson (1993) in study of 20 countries and was subsequently picked up by the World Bank in its 1997 "Expanding the Measure of Wealth" and then termed ANS. Since 1999 the ANS indicator is part of the World Bank's "World Development Indicators" and now covers more than 130 economies. Recently, the ANS pollution damages were expanded to include not only CO2 but also PM. There is no information on ongoing or future plans to revise the ANS methodology.

III. Data	
g. How is the underlying data gathered and by whom?	The ANS indicator is compiled by the World Bank using official and publicly available data from many sources including the UN family of organizations, agencies, and programs, national statistical offices, academic research studies, and corporations (e.g., BP).
h. How accurate are the results (e.g. is the result an estimate, are there data gaps, imputations, assumptions, etc)?	The data sources used to calculate ANS are generally considered reliable. However, many data gaps persist including within available time series as well as across countries. Certain types of information that is necessary for estimating human and natural capital, such as private education expenditure or marginal costs of extraction, are generally not available. Such data gaps are addressed either by omitting the item (e.g., not including private education expenditure in ANS) or by imputation using regression methods and inter- or extrapolation. Thus, the resulting ANS values must be considered estimates.
i. How often is the indicator recalculated/released? Have there already been any major indicator revisions?	Since 1999 the World Bank publishes ANS in its annual World Development Indicators. The most recent year available is 2007 for 130 countries. Country coverage has been increasing since first release. No major revisions have happened aside from the inclusion of estimated pollution damages from PM in addition to CO2.
IV. Link to sustainable development	
j. Is there an operational definition of sustainability 'built-in' to the methodology?	The operational definition of sustainability used in the ANS derives from a growth theory perspective: **Current change in net savings equates to present value of changes in future consumption** (Ferreira et al., 2008). Thus, ANS implies weak sustainability because all forms of capital (man-made, human, and environmental) are considered equally important with no requirement to maintain natural capital so as to ensure critical or life-preserving environmental services can flow ad-infinitum. Positive ANS does not guarantee sustainability, i.e., is necessary but not sufficient condition. Negative ANS indicates unsustainable state but more relevant is the analysis of time trends since sporadically negative ANS could still mean long-term sustainability if investments overall exceed consumption of all three types of capital. In theory, exhaustive accounting of forms of investment and consumption and depletion of human and natural resources and by applying the Hartwick rule, ANS would be a weak sustainability indicator.
k. If yes, does the indicator measure 'strong' or 'weak' sustainability?	The ANS indicator may indicate weak sustainability if non-negative but more comprehensive accounting of investments in human capital and depletion and degradation of natural resources necessary.
l. Does the approach have numerical value(s) assigned to sustainability (e.g. a thresholds/ irreversabilites below which a region/activity is not sustainable)?	Negative ANS values are indicative of unsustainability. Non-negative values, especially if maintained over long periods of time and significantly above zero provide cautious evidence for weak sustainability.
m. Please describe the key methodological links to highly related indicators (what exactly are the commonalities and differences among these indicators)?	Methodological links to conventional economic accounting measures include: • Net National Savings via the identity ANS=Net National Savings + education expenditures – natural resource depletion • Consumption measures because changes in ANS correlate positively with present value of changes in consumption in future (Dasgupta, 2001; Hamilton and Hartwick, 2005) • Links to the SNA and the SEEA-2003 because it can be calculated from these frameworks Methodological links to social indicators include: • Accounting measures of human welfare because it focuses on consumption and not GDP growth and as such is more of welfare oriented. Methodological links to environmental indicators include: • Accounting measures of natural resource depletion and degradation measures because ANS accounts for the depletion and pollution damages of a limited set of natural resources.

n. What are the key "bridging" links to other dimensions of sustainability (environmental, social, economic) and are there any explicit hybrid measures incorporating multiple dimensions in a single metric (e.g. GHG intensity—GHG emissions per unit of GDP).	The ANS indicator is a hybrid measure linking all three dimensions of SD, i.e., • The economic dimension is captured because ANS is a savings measure and derived from GROSS NATIONAL SAVINGS. • It captures a social element due to the inclusion of human capital, although this dimension requires expansion and better theory to estimate investment in human capital. • The environmental dimension is captured via the subtraction of natural resource depletion and pollution damages. ANS is also linked via the accounting framework to: • GNP • Adjusted versions of GDP such as Environmentally Adjusted GDP (EDP) and Environmentally Adjusted Capital Formation (ECF) because: o ANS=GNS-CFC+E-NCD o NDP=GDP-CFC and EDP=NDP-NCD, which means: o ANS = GNS+E+EDP-GDP o Where GNS is Gross National Savings, E is education expenditures, EDP is Env. Adjusted GDP, CFC is Fixed Capital Consumption, NCD is Natural Capital Depletion, and GDP is Gross Domestic Product.
V. Institutional Analysis	
o. Which institutions are currently using the indicator, and for which purposes?	The institutions currently using ANS include: • The World Bank, which produces and releases ANS annually. • The UN Division for Sustainable Development, which included ANS in 3rd revision of its Blue Book (UNDSD, 2007). • The WRI, which reports ANS in its EarthTrends database. No government or regional governmental entity (e.g., EU) has legally adopted ANS as of yet as a measure of genuine savings
p. What are the driving forces and characteristics that affect institutional adoption (consider this question from the perspectives of political science, sociology and political economy)?	Institutional adoption is primarily hampered by these issues: • There remain limitations and controversies in the accounting methodologies used to calculate ANS such as for estimating resource rents and investments in human capital. • The extent of missing data on the extraction cost and damages arising from natural resource use. • The lack of monetary values for non-market environmental services (e.g., non-timber benefits of forests). • The hesitation on the side of economists, national accountants, and statisticians to adjust key macro-economic indicators such as GDP, Capital Formation, and Income.
q. Are there links to international or European laws, conventions or agreements (this could range from an explicit legal requirement to a general policy concern)?	Links of ANS to international and European laws, conventions, or agreements include: • The EU SD Strategy, which does not specify ANS but its underlying growth theory perspective and savings methodology would make it a potential candidate indicator. • The EU Lisbon Strategy, for the link to economic growth. • The Johannesburg Summits Plan of Implementation Chapters III and IV, which renews the call for measurement of sustainable development.
VI. RACER Analysis	
Criteria and Sub-criteria	**Analysis**
Relevant	
POLICY SUPPORT	+ ANS directly relates to the Lisbon Strategy because it informs about the potential growth/decline of economic growth as a result of current savings patterns. + ANS is directly related to SD Strategy because it informs if current economic activity is causing increase or decrease in wealth and hence potential for weak sustainability or unsustainability. + ANS quantifies present value of future consumption levels. – ANS uses weak sustainability criterion.

	– ANS excludes many important natural resources and environmental services. – ANS implies that public education expenditure translates 1:1 to human capital. – ANS's current methodology does not incorporate population growth, which could have measurable impact on future consumption levels on a per capita basis for countries with high population growth rates.
IDENTIFICATION OF TRENDS	+ ANS reflects changes over time in a consistent manner. + ANS quickly reacts to changes in savings attributable to the selected resources. – ANS may not reflect changes in depletion or disinvestment in other resources that are not included in the formula. – In developed countries ANS correlates little with changes in future consumption because it does not factor in technological change and innovation. – Exclusion of population growth in ANS may overestimate potential future consumption on a per capita basis, especially in countries with rapidly growing populations. – There exists no systematic sensitivity and robustness analysis of the methodology and hence the impacts on trends of different assumptions and data used are not fully known.
FORECASTING AND MODELLING	+ The consistent methodology of ANS allows the forecasting of future savings and consumption potentials with the limitations stated above. – Is has not been tested how shocks to the economy due to, for example, resource scarcity or economic crisis affect the indicator. – It has been shown that economic growth and ANS weakly correlated in developed countries. – The current ANS methodology implies weak sustainability so that thresholds or irreversibilities in natural resources and environmental services may not be detected ahead of time. – There exists no systematic sensitivity and robustness analysis of the methodology and hence the impacts on trends of different assumptions and data used are not fully known.
SCOPE/LEVELS OF APPLICATION	+ ANS is theoretically applicable at various scales from local and national to regional and global. – The calculation of the ANS indicator is data intensive and partly due to this ANS does not account for several important items for human and natural capital.
Accepted	
STAKEHOLDER ACCEPTANCE	+ Aside from SEEA-2003 the ANS is probably the most advanced accounting-based indicator with some level of international credibility and endorsement. – The limitations of methodology and concern over weak sustainability paradigm hamper wider adoption of the ANS.
Credible	
UNAMBIGUOUS	+ If calculated with consistent data, the ANS is quite unambiguous in trend and comparable across countries, although important trends or effects may go unnoticed because these items are not included. – The exclusion of many types of natural resources and services may hide important increases or decreases in wealth and thus yield misleading results. – The exclusion of technological developments may limit its use as a predictor for future consumption levels in developed countries. – The exclusion of population growth may limit its use as a predictor of future consumption levels in developing countries. – The ANS's weak sustainability paradigm may lead to wrong policy conclusions regarding sustainability of the economy.
TRANSPARENCY OF THE METHOD	+ The ANS formula is clear, transparent, and systematically described in Bolt et al. (2002). + Empirical studies exist for ANS, which shed further light on the

	methodology and its problems.
Easy	
DATA AVAILABILITY	+ World Bank calculates national ANS annually for more than 130 countries, so data is available, albeit imputations and assumptions are necessary. – Data intensive and for most countries no complete time series and no complete set of the necessary data are available so that imputations and assumptions have to be made.
TECHNICAL FEASIBILITY	+ Calculation of the ANS is technically feasible as World Bank exercise has shown. – Full cost accounting for all forms of natural and human capital most likely prohibitive at present (aside from the controversies surrounding their monetary valuation).
COMPLEMENTARITY AND INTEGRATION	+ The ANS has a direct link to the SNA and SEEA. + The ANS is among the more feasible bridge indicators for integrating SD concerns into conventional macro-economic indicators. – ANS is nonetheless a limited indicator of sustainability as methodological limitations show and thus should be used with caution.
Robust	
DEFENSIBLE THEORY	+ The ANS methodology is integrated into economic growth theory (albeit with a welfare focus) and linked to national accounting standards, although estimation of human capital could be developed further. – The ANS implies a weak sustainability criterion. – The ANS comprises an incomplete accounting of human and environmental capital. – To date there is no generally accepted compromise on valuation methods.
SENSITIVITY	+ ANS can detect year-to-year changes in savings patterns for the components that are included. – Due to incomplete accounting of all forms of human and environmental capital ANS might miss important trends in other forms of capital. – Weak sustainability means all forms of capital are interchangeable and hence positive ANS may mask ongoing deterioration of environmental capital, which may ultimately lead to permanently reduced consumption potential.
DATA QUALITY	+ The accuracy of the ANS indicator depends on accuracy of input data, which varies from country to country but World Bank analysis claims that data are of generally high quality.
RELIABILITY	– Does not measure sustainability with present methodology.
COMPLETENESS	– The ANS represents an incomplete accounting of all forms of human and environmental capital.
Summary appraisal	+ ANS is a widely accepted first step toward adjusting conventional macro-economic accounting measures within the framework of the SNA. As such it is a useful complement to GDP and other key economic indices. + ANS has been shown in empirical studies to be able to identify economic patterns that are not sustainable, primarily resource rich developing countries ('resource curse'). + Calculation of ANS is transparent and a step-by-step manual exists (Bolt et al., 2002). + Annual figures are available for a growing number of countries from the World Bank. + ANS methodology is under ongoing review by the World Bank and has potential to be expanded to include other environmental assets. + ANS can be used for sensitivity studies, for example, for testing the effect of different valuation or costing methods.

	+ The ANS can estimate time trends. – The ANS is not a true sustainability measure due to limitations in the included forms of capital and the underlying sustainability paradigm (weak sustainability). – Many methodological issues remain to be solved. – Data intensive, especially when considering full cost accounting, and thus not easily implemented in resource scare settings. – ANS is not widely adopted in governmental reporting and policy-making. – There is no known international strategy to further develop and ultimately adopt ANS.
VII. Supplemental RACER policy analysis	
Policy Target	**Does the indicator reflect this target?**
CLIMATE CHANGE AND CLEAN ENERGY	ANS partially measures climate change and clean energy because it includes energy depletion of crude oil, natural gas and coal (hard and lignite) and damages from CO_2 emissions but no renewable energy sources and no comprehensive assessment of damages from all GHG emissions.
SUSTAINABLE TRANSPORT	ANS does not cover sustainable transport.
SUSTAINABLE CONSUMPTION AND PRODUCTION	The ANS compares consumption versus income as a first step to obtain GROSS NATIONAL SAVINGS and if ANS is non-negative current consumption patterns allow for increase in future consumption. Its use of a weak sustainability paradigm, however, means that sustainability of consumption and production vis-a-vis critical ecosystem functions cannot be assessed.
CONSERVATION AND MANAGEMENT OF NATURAL RESOURCES	ANS corrects conventional savings (GNS) by subtracting resource depletion and damages from pollution. Thus, indirectly, ANS can shed light on whether resource extraction and pollution trends exceed the production of man-made capital and create negative savings. ANS does not guarantee preservation of critical environmental services and goods.
PUBLIC HEALTH	The ANS does not cover public health.
SOCIAL INCLUSION, DEMOGRAPHY, AND MIGRATION	The ANS does not cover social inclusion, demography, and migration.
GLOBAL POVERTY AND SUSTAINABLE DEVELOPMENT CHALLENGES	The ANS does not cover global poverty and sustainable development challenges.
INVESTMENT IN RESEARCH AND DEVELOPMENT	The ANS includes only public education expenditures.
UNEMPLOYMENT RATE	The ANS does not include the unemployment rate.
r. How does the indicator help measure progress toward the policy targets (marked 'Yes' and 'Partially, above)? What are the advantages of using this indicator?	The ANS combines conventional concepts of economic growth and income with adjustments for the depletion of natural resources, pollution damages, and investments in human capital; All in the context of an accounting system such as the SNA. Substantial limits as a sustainability indicator. Time series data available from World Bank for some 130 countries in 2007. Thus, ANS is a useful bridging measure of economic performance and sustainable development. Relatively data intensive but already tested and implemented by World Bank. Methodology offers much room for expansion of the assets covered as well as testing of different valuation and costing methods.

s. What are the most important pitfalls of using this indicator as a measure of progress to the policy targets (marked 'Yes' and 'Somewhat', above)?	An important pitfall is to equate positive ANS with sustainability. At best, negative ANS is indicative of diminished consumption potential in the future and consistently well above zero ANS may indicate weakly sustainable economy. Omission of population growth and technological change may obscure the signals of ANS.
VIII. Potential Links with Other Indicators (further detail to be collected in the 'basket analysis')	
t. What other indicators could be combined in a basket with the one in question to address specific policy challenges relevant to the EU policy framework?	GDP, ANS, ISEW (GPI), and EF together can give more information than any single indicator on: • Economic growth. • National savings (per unit GPD or as %GNI). • Trends in national and per capita welfare and a comparison of income and consumption levels. • Consumption patterns and carrying capacity.
V. SWOT Analysis	
u. *Core strengths (*Core strengths are the strongest aspects and main advantages of the indicator that may be unique to the indicator in question.)	• The ANS is linked to GNI and GROSS NATIONAL SAVINGS while making adjustments for depletion of key environmental assets and pollution damages as well as investment in human capital. • Its theory is also easy to understand.
v. *Important strengths (*Important strengths are those strengths that are highly significant but that may be shared with a host of other indicators.)	• ANS offers several advantages over other traditional economic indicators. First, it highlights the need to increase domestic savings and therefore can help promote sound government macroeconomic policies. In comparison, GDP rises as resource depletion increases. This can distort estimates of national income and growth, especially for resource-dependent economies (Hamilton, 2000). ANS can provide a more balanced measure. • ANS can make resource use and environmental decisions much more apparent in economic decision-making: environmental trade-offs immediately become much more explicit (World Bank, 2009). The indicator translates resource issues into a framework that financial and economic ministries can easily understand. It also highlights the financial consequences of resource use and may suggest collection of resource royalties in order to more efficiently use the rents gained from resource extraction. • Possibility to expand the list of environmental assets and pollution sources included in ANS, so it's flexible and adopting countries or institutions can gradually expand the list of assets.
w. *Critical weaknesses* (Critical weaknesses are any weaknesses that may preclude implementing the indicator at an EU level. Unless a critical weakness is fixed, it is inadvisable or impractical to use the indicator at the national or EU level.)	• There are large uncertainties in estimates of fixed capital consumption, natural resource depletion, and in total wealth estimates (Hamilton, 2005). In particular, incomplete data in a 2001 World Bank analysis affected ANS estimates for 92 countries or 4.6 billion people (Pillarisetti, 2005). • Empirical evidence shows that the relationship between ANS and social welfare is positive, but this relationship is not necessarily very strong (i.e.: Hamilton, 2005; Hamilton, 2000; Ferreira and Vincent, 2005; Gnegne, 2009). Hamilton (2000) found that there are many countries with declining wealth but positive genuine savings. Ferreira and Vincent (2005) and Gnegne (2009) add that ANS provides a better gauge of the difference between current and future consumption for non-OECD countries than OECD countries. • In calculating ANS, the World Bank does not account for changes in population. Hamilton (2000) points out that for the most countries below the median per capita income, the population is growing faster than national savings or wealth.
x. *Important weaknesses* (Important weaknesses, in contrast, limit the usefulness of the indicator	• Economists and scholars debate the utility of ANS as an indicator because of its orientation toward weak sustainability. • The indicator, as computed by the World Bank, does not include changes in all capital stocks.

in question but do not wholly prevent the indicator from being implemented as an EU policy tool.)	• ANS adds, dollar for dollar, educational expenses to the estimate of national savings. Calculations do not account for the efficiency of educational spending and exclude private educational spending. • ANS receives criticism for unfairly biasing measures of sustainability towards wealthy countries and against developing states. The World Bank does not thoroughly consider the implications of imported resources, making developing countries look less sustainable then they otherwise would. • Calculations of damages caused by CO_2 emissions may also unfairly shed a more positive light on developed countries over their developing neighbours. The US accounts for nearly one quarter of global anthropogenic CO_2 emissions even though it contains just under 5% of the world's population (Pillarisetti, 2005). The ratio of CO_2 damages to GDP, however, is one of the lowest of any country in the world at 0.4%. Azerbaijan, in comparison, emits only 0.18% of the total global CO_2 emissions, but the ratio of damage to GDP in this country is 5.4%. The United States is arguably causing far more harm in terms of climate change than is Azerbaijan, but in terms of genuine savings, the US appears much more sustainable.
y. Opportunities (This category of the SWOT analysis lists the most important opportunities that could help improve the indicator or that could help guide successful implementation of the indicator.)	• ANS is both compiled and advocated by the World Bank. This means that ANS currently has a high level of both technical and some institutional support. Although there are major shortfalls in the ANS, the indicator has sufficient institutional backing to facilitate future methodological improvements and better data collection.
z. Threats ('Threats' are institutional, political, intellectual, and technological environments that could most likely act as barriers in the future to successful adoption of the indicator.)	• Institutional and market barriers could prohibit improved data collection. For example, most mining companies will not release production costs for metals and minerals, making it difficult to reliably calculate reductions in natural capital.

5 Evaluation of the Indicators as a Group

The set of indicators is not only evaluated individually but also as groups or baskets of indicators. The motivation of this exercise lies in the objective to complement the main macro-economic indicators with additional environmental and social metrics so that a more complete and nuanced picture of countries' path toward sustainability can be drawn. The indicators in a basket are then analyzed in analogous fashion to the single indicator evaluations but with greater emphasis on

5.1 RACER Analysis of the Basket of Indicators

Although the basket of GDP, ANS, and SEEA allows for a more nuanced depiction of economic performance and its relationships to the environment, none of the three indicators/frameworks individually and as a group measure true sustainability with respect to

either a strong or weak sustainability criterion. However, especially the SEEA and the ANS could be expanded to cover a maximum of natural resources and their depletion or degradation. Trends in the individual measures might go into opposite directions, e.g., positive GDP but negative ANS, which does not pose a contradiction but an opportunity for a more fine-grained and truthful sustainability analysis. At the same time, the basket of GDP, ANS, and SEEA cannot set an unequivocal sustainability value or threshold. It also does not warn of reaching critical tipping points or thresholds with no reversibility.

VII. Indicator Summary	
Name of indicators in the basket	GDP, ANS, SEEA
Indicator category	Economic
Criteria and Sub-criteria	**Analysis**
Relevant	
POLICY SUPPORT	+ GDP, ANS, and SEEA together measure (1) the total market value of all goods and services produced in the market sphere in an economy during the accounting period, (2) the monetary savings rate taking depletion and degradation of selected environmental capital as well as an estimate of the investment into human capital into account, and (3) offer a framework for a host of further indicators of economic-environmental relationships (and sustainability). Thus, as a basket the three indicators support and enhance each other and have demonstrated policy relevance for characterizing the degree to which an economy is on a sustainable path with respect to its use of environmental goods and services. – None of the three indicators/frameworks individually and as a group measure true sustainability with respect to either a strong or weak sustainability criterion. However, especially the SEEA and the ANS could be expanded to cover a maximum of natural resources and their depletion or degradation. – Human capital and other aspects of sustainability are not adequately measured in the basket and it can hence not inform about the social dimension of sustainability.
IDENTIFICATION OF TRENDS	+ If calculated on a regular basis from high quality data, all three indicators/frameworks individually provide reliable trend information. To what extent the individual trends agree with each other in terms of giving an unambiguous overall perspective on environmental sustainability would need to be tested. + Trends might go into opposite directions, e.g., positive GDP but negative ANS, which does not pose a contradiction but an opportunity for a more fine-grained and truthful sustainability analysis. + ANS as a savings measure is a more forward-looking sustainability indicator because positive savings today are likely to permit increased consumption in the future (although ANS as currently calculated does not account for population growth or preservation of critical environmental services) – There is debate about how to interpret a negative ANS value: although it indicates that the capital base was being reduced in the accounting period, it could be possible that the net present value of the capital (built, human, environmental) that is generated in the future from the resources extracted in this accounting period may exceed the value of the current decline in assets. It can be compared with going into debt to start a new business, which if successful generates more revenue than the initial amount borrowed. Several periods of negative ANS may therefore be a more reliable sign of unsustainability than a single negative value.

	– The basket of GDP, ANS, and SEEA cannot set an unequivocal sustainability value or threshold. It also does not warn of reaching critical tipping points or thresholds with no reversibility.
FORECASTING AND MODELLING	+ The shared and expanded accounting principles on which all three indicators/frameworks rest offer themselves to forecasting and modelling, e.g., it allows the identification of the processes that might underlie a growing GDP but declining ANS. The rich SEEA information can shed further light on economy-environment relationships that can be used to forecast and model items such as resource stocks and flows and their effects on pollution levels. – All three measures/frameworks, if implemented fully, are very data intensive, although the data overlap to some extent due to the shared accounting basis. Thus, substantial investment is needed into data collection and analysis infrastructure in order to obtain informative, reliable, and comprehensive forecasts.
Accepted	
STAKEHOLDER ACCEPTANCE	+ The basket of GDP, ANS, and SEEA is one of the most widely accepted set of indicators/frameworks in the sustainable development community, although all individually and taken as a group have limitations and shortcomings (e.g., the items included and the valuation methods used). + If the debate in the EU continues to move toward 'complementing GDP' instead of replacing it, ANS and SEEA are well positioned to do that. – There are disagreements among stakeholders regarding a number of methodological issues concerning the individual measures (discussed in the single indicator reports), although it seems to be accepted that relying on a single (flawed) measure of sustainability is not useful.
Credible	
UNAMBIGUOUS	+ ANS and SEEA-based indicators can inform about whether the achieved GDP is unsustainable (e.g., negative ANS). – Ambiguity exists with respect to the interpretation of the indicators (incl., those derived from the SEEA) individually and as a basket as to whether the economy is on a sustainable path. – The basket of GDP, ANS, and SEEA cannot set an unequivocal sustainability value or threshold. It also does not warn of reaching critical tipping points or thresholds with no reversibility.
TRANSPARENCY OF THE METHOD	+ The methods to calculate GDP, ANS, and indicators in the SEEA are transparent. – Calculating the measures requires specialized training in national and environmental accounting principles and methods.
Easy	
DATA AVAILABILITY	± Data to calculate GDP are generally available but are usually incomplete for ANS and SEEA. – In most instances it is not possible to calculate the basket of GDP, ANS, and SEEA-derived indicators on a regular and accurate basis.
TECHNICAL FEASIBILITY	+ The data basis for calculating the basket is growing slowly but there is a renewed interest by EU countries and poor countries with economies relying strongly on the extraction fo natural resources to develop the data collection and analysis infrastructure to compile environmentally adjusted macro-economic indicators and/or SEEA satellite accounts. + The continued development and publication of methodological handbooks also facilitates the calculation of the indicators in the basket. + Further impetus is expected to come from the elevation of the SEEA to an international statistical standard by the UN Statistical Commission in 2010. – The degree of technical expertise and the required amount of data poses a hurdle in the widespread adoption of this basket. – In addition, where methodological disagreement exists the SEEA discusses the different approaches without giving clear guidance on which one to choose in what situation. This neutral stand has been cited as a hindrance to the more widespread and faster adoption of the SEEA since its inception in 1992.

COMPLEMENTARITY AND INTEGRATION	+ The GDP, ANS, and SEEA complement each other in several ways: GDP measures economic performance, which is supplemented by a environmentally and socially adjusted savings (i.e., a forward-looking capital maintenance measure) and further supported by information on the stock and flows (perhaps also value) of environmental assets, the pollution generated by economic activity, and the resulting damages to future environmental resource streams. + GDP, ANS, and SEEA are all linked and to a high degree integrated via the System of National Accounts. – None of the measures/frameworks adequately assesses the social dimension of sustainability, e.g., human capital and wellbeing.
Robust	
DEFENSIBLE THEORY	+ The underlying accounting principles are to a high degree accepted and based on sound accounting theory. – Valuation of environmental goods and services becomes problematic when they are not traded in the market place, have inter-generational value, represent critical forms of capital, or are traded or exchanged in such small quantities or such diverse forms that monetary values are not reliable or comparable. – Different valuation methods have been developed but they sometimes lead to very different results (e.g., WTP v. WTA) and no uniformly accepted standard has yet emerged.
SENSITIVITY	+ The basket of GDP, ANS, and SEEA allows for a more nuanced depiction of economic performance and its relationships to the environment. + Although sustainability cannot be measured with confidence and accuracy by the indicators in the basket, the information on the status of the environment added by ANS and SEEA indicators increases the sensitivity of GDP to detect unsustainable trends. – It has not yet been tested to what extent the combined picture offered by GDP, ANS, and SEEA-based measures are sensitive to assumptions or specific conditions in the economy-environment nexus.
DATA QUALITY	+ In an EU context it can be assumed that data quality is generally adequate. – Data may not be complete to calculate ANS or SEEA-based indicators.
RELIABILITY	+ The basket increases reliability of the conclusions regarding sustainability compared to any single indicator in the basket. – The omission of a number of components and concepts reduces the reliability of the basket as a sustainability measurement tool.
COMPLETENESS	+ The combination of GDP, ANS, and SEEA can shed a fairly complete picture on the interactions between the economy and the environment. – Several important components of sustainable development are not covered, including: • Risks and their severity and probability • Thresholds and tipping points • Social aspects and social capital • Weighting of environmental impacts according to their severity, e.g., toxics • Environmental goods and services not covered by ANS and SEEA
Summary appraisal	+ GDP, ANS, and SEEA as a basket may offer one of the more appealing combinations of economic and environmental indicators. + ANS and SEEA are gaining momentum as tools to complement GDP. + While not measuring sustainability, they can be used to identify trends and relationships in GDP growth and the protection of natural resource streams into the future. – Many methodological issues remain to be resolved. – Social dimension is not adequately represented. – So far, all sustainability values mentioned in connection with ANS and SEEA are based on a weak sustainability definition and are at best approximations.

Bridging shortfalls: How does the basket of indicators either bridge or augment the shortfalls in the individual indicator?	The known shortcomings of the ubiquitous GDP as a sustainability indicator are partially overcome by ANS and the SEEA framework. ANS adds a savings dimension that takes into account environmental depletion and degradation (albeit incompletely due to data and methodological issues) and to a very limited extent by counting public education expenditures as investment in human capital. As a savings measure, it is focused on a capital maintenance approach, which is a natural way of looking at sustainable production and consumption patterns. The SEEA framework corrects the accounting flaws in GDP to (a) not count environmental goods and services not traded in a market place, (b) internalizing the externalities of economic activities, (c) attempting to put monetary values on environmental assets, their depletion and degradation, and (d) allowing a more complete stock-taking of environmental capital.
Ease of interpretation: When listed side-by-side, are the indicators in the basket easy to read and interpret as indicators? (For example, what if one indicator listed a positive trend while another listed a negative trend?) Alternately, is it more difficult to interpret the indicators as a basket than if each indicator were used stand-alone?	The addition of ANS to GDP allows for a more nuanced analysis of economic performance and the impacts it might have on natural resources and environmental degradation. Thus, GDP and ANS may show opposing trends but they can be interpreted within a sustainability framework and used to identify the driving factors of the trends in GDP and ANS. Adding additional detail from the SEEA to the picture can further illuminate what processes and activities are causing an upward trend in one measure and a downward trend in the other. Thus they enhance each other.
Key advantages and disadvantages of the basket: What are the main advantages and disadvantages of using the basket over using either indicator as a stand-alone measure?	Key advantages: • ANS and SEEA-derived indicators tell more about the environmental 'toll' of economic growth measured in GDP. • SEEA expands the economic boundaries of the accounting system, hence more complete accounting (internalization) of environmental goods and services as well as depletion and degradation. • ANS adds a forward-looking, capital maintenance perspective to GDP and accounts partially for environmental depletion and degradation and a proxy for investment in human capital. • All three use accounting principles and share to some extent the same data basis. • The accounting framework facilitates adoption by economic planners and other line ministries used to thinking in terms of monetary values. Key disadvantages: • No sustainability value available, only indicative of unsustainability or sustainability (such as negative and non-negative ANS). • Data intensive. • High degree of technical expertise required to be able to compile the accounts and calculate the measures, although handbooks are available. • Methodological issues remain, including regarding the valuation of many types of environmental goods and services.
a. Critical strengths	GDP, ANS, and SEEA are probably the most developed troika of economy-environment indicators and frameworks. They share many established and widely used accounting principles and have appeal because they expand the economic boundaries of the system while maintaining close linkages to the System of National Accounts.
b. Important strengths	The basket can be developed further, e.g., by incorporating additional components into ANS or expanding the SEEA set of satellite accounts. Continued methodological refinement is taking place under leadership of major international organizations (WB, UN, Eurostat, IMF, OECD). Long time series and nearly global coverage are available for GDP and to a lesser extent for ANS. Joint analysis of GDP, ANS, and SEEA-derived indicators can shed light on the drivers of economic growth and their environmental costs and impacts. Unsustainability can be gauged from negative ANS and indicators derived from the SEEA.
c. Critical weaknesses	No intrinsic sustainability threshold or value associated with an individual indicator or jointly as a group.

d. Important weaknesses	Methodological issues remain with respect to the valuation of environmental goods and services and the factoring in of intergenerational equity. Several important aspects of sustainable development are also not covered by the basket, incl.: • Risks and their severity and probability • Thresholds and tipping points • Social aspects and social capital • Weighting of environmental impacts according to their severity, e.g., toxics • Environmental goods and services not covered by ANS and SEEA ANS may be of limited use in developed countries as it does not reflect technological innovation. In countries with rapid population growth ANS may also be problematic because it does not take population growth into account. Additional hurdles are posed by the relative data intensity and level of technical expertise needed to develop the necessary accounts, although the ongoing and further development of publications and handbooks together with training workshops can reduce this obstacle.
e. Opportunities	The revision of the SEEA-2003 is expected to be completed in 2010 and to be elevated to an international statistical standard. This can boost the acceptance and uptake of the SEEA. Further refinement of the ANS, e.g., by improving valuation methods and including additional types of environmental capital.
f. Threats	Perhaps the biggest threat might arise from a continued disagreement over certain methodological aspects and the continued absence of clear advice on the construction of sustainability indicators in the revised SEEA.

6 Unresolved Methodological Issues

The present indicator evaluation has to be seen in the context of several limitations and shortcomings. Nonetheless offers the information gathered a useful point of departure for integrating mainstream economic concerns with the environmental and social aspects of sustainable development. It becomes clear, for example, that no single indicator is as of yet measuring environmental or social sustainability of economic activity. Indicators based on and derived from accepted accounting frameworks such as the SNA see their strengths originating from the ties to and systematic application of economic accounting rules diminished by methodological difficulties comparable to those identified for more loosely organized indicator frameworks, including how to make items measured in different units comparable, how to determine weights for aggregating items, and how to value the future compared to the present. The present evaluation paid particular attention to capturing the more nuanced differences among the selected indicators. For example, it takes a close look at the underlying explicit or implicit sustainability criterion. On the other hand, this attention to detail meant that the number of selected indicators had to be quite small in relation to the magnitude of existing measures. A number of additional challenges remain, which are discussed in the following sections.

6.1 Methodological Challenges

Often, the criteria for selecting an indicator into a study is well motivated and explained but the reasons for not including an indicator into the basket is not given. This note is no exception although we tried to define an a-priori set of indicators to which we then applied the selection criteria. The reasons for choosing the Eurostat list, however, are mainly convenience and its relative comprehensiveness vis-à-vis the diversity of measures represented by it. Restricting our attention to this list means that metrics not on it had an a-priori probability of zero of being selected even though they might be more suitable for the purpose of this study than those on our final list.

A second methodological issue is given by the evaluation methodology itself, i.e., by the RACER and SWOT analysis and their extensions. Judging a diverse group of indicators according to a fair standard requires a certain abstraction from detail. Yet, at the same time we wanted to make sure to be able to detect the nuanced differences among indicators that are otherwise very similar (e.g., ANS and eaNNP). We accomplished this by formulating open-ended questions that leave some leeway to inject specific characteristics unique to the indicator being evaluated. We also allowed frameworks such as the SEEA to be evaluated even though this does not lead to the recommendation of a single indicator. However, we felt that a system such as the SEEA represents an important step towards the systematic integration of environmental and economic concerns that choosing an indicator that can be calculated from it, would not adequately reflect the utility of the whole framework.

A side effect of the evaluation methodology is that it is not meaningful to try and derive quantitative statements about the indicators regarding their ability to bridge economic and environmental or social aspects of sustainable development. It is an inherently qualitative description of this ability and any scoring mechanism would be subjective. Therefore, decisions in favor or against using an indicator also remain to some extent subjective.

6.2 Communicating Uncertainties

The proper estimation and communication of uncertainties in the values of an indicator is often overlooked in policy reports and the decisions based thereon. On the other hand, speaking already about a positive trend when the concentration of a pollutant in freshwater bodies has been declining slightly for the past few years without considering the error due to sampling and measurement methods is risky and can be misleading. The degree to which indicators are subject to different types of errors varies but in most cases, the potential for

random and systematic variation in the indicator values should be made transparent. The present indicator evaluation looks at data quality and completeness as a source for uncertainty but cannot give estimates of uncertainty for any of the indicators. If nothing else is available, data quality – broadly understood – should always be factored into the decision to adopt or reject an indicator. Even if the indicator truly measures sustainability, a large measurement uncertainty could render it useless. Uncertainty in an indicator may also change over time or from place to place, which also needs to be communicated. For example, technological and scientific advances may have led to an increase in the precision and accuracy with which the indicator can be measured while differences in resources, staff, and density of monitoring network may mean the indicator is measured with different levels of accuracy and precision in different places. When the indicator is based on a sample survey, the design effect and sampling error can often be estimated. Macro-economic aggregates such as GDP are usually reported as a single figure, suggesting a false level of precision and accuracy. On the other hand, the checks and balances of the accounting system and its continued improvement over decades mean that GDP and other figures come with a high level of confidence. This is less likely the case for new indicators of sustainability where the methodology is still under development and assumptions made have not yet been tested empirically for their effect on the indicator. Thus, it is important for an indicator to become accepted and used that its inherent uncertainties are discussed and made transparent.

7 Final Summary and Conclusions

The evaluation of the indicators GDP, the Adjusted Net Savings indicator (ANS, also known as Genuine Savings), and the System of integrated Environmental and Economic Accounting 2003 revision (SEEA-2003) individually and as a basket yielded a number of insights that can inform policymakers in the EU Commission and Member States about the linkages, synergies and trade-offs, between the goals of economic growth and competitiveness on the one side and environmental protection, sustainable management of natural resources, and social cohesion and well-being on the other.

First of all, and it is well-known, GDP is not a useful measure of well-being or environmental sustainability and should either be replaced by a more comprehensive measure or – and this is the objective of the IN-STREAM project and the current trend in the EU – be complemented by additional aggregate indicators that capture the environmental and social dimensions.

ANS and the SEEA-2003 framework are both accounting-based measures, albeit the SEEA is a framework and as such offers the calculation of a host of natural resource and environmental indicators. Both expand the conventional boundaries of the economic system to include environmental assets as well as environmental pollution. In addition, ANS includes one element of social capital and that is investment into human capital via public expenditures. Since this is the only item on the social dimension and is a rather crude estimate, it remains questionable to what extent the ANS adds useful value as a social sustainability measure. However, its contributions to capturing elements of natural resource depletion and pollution generation are well founded and a meaningful addition to the conventional macro-economic indicators led by GDP.

The SEEA is the only comprehensive environmental accounting system to date and which has good chances of being elevated to an international statistical standard upon the completion of the revision of the 2003 version in 2010. This would greatly promote its adoption world-wide as the environmental accounting tool of choice and thereby indirectly facilitate the generation of more widely comparable indicators of environmental sustainability.

As complete as the treatment of the various types of environmental accounts in the SEEA-2003 is, the developers acknowledge a number of methodological and systematic shortcomings that arise when one tries to integrate environmental management into an economic accounting system. The valuation of environmental services remains controversial with no consensus in sight. A number of environmental services are intrinsically difficult to measure whether in physical or monetary terms, such as biodiversity and aesthetic values. Therefore, while the SEEA certainly has high potentials to become an information system for governments and international bodies, there is still room for continued improvement as well as other indicators.

The basket analysis revealed that GDP, ANS, and the SEEA form a complementary system of measures that overlap to a certain extent but that each add value by giving a perspective of sustainability of the system that the others do not. GDP based on the System of National Accounts and the SEEA-2003 are the most complementary and complete while ANS adds a single aggregated indicator that – as the World Bank has demonstrated – can be compiled at reasonable cost, defensible assumptions, and on a globally comparable basis. It may thus be more useful in the short to medium term as SEEA adoption progresses and together with the SNA forms the data and methodological basis for national accountants.

8 References

AUTY, R. M., 2007: Natural resources, capital accumulation and the resource curse, In *Ecological Economics* 61: 627-634.

BARTELMUS, P., 2007: SEEA-2003: Accounting for sustainable development? Commentary in *Ecological Economics* 61: 613-616.

BEST, A., GILJUM, S. ET AL., 2008. Potential of the Ecological Footprint for monitoring environmental impacts from natural resource use: Analysis of the potential of the Ecological Footprint and related assessment tools for use in the EU's Thematic Strategy on the Sustainable Use of Natural Resources. Report to the European Commission, DG Environment.

BOLT, K., MATETE, M. AND CLEMENS, M., 2002: Manual for Calculating Adjusted Net Savings, Environment Department, World Bank, Washington D.C.

BUREAU OF ECONOMIC ANALYSIS, 2000: GDP: One of the Great Inventions of the 20th Century. Survey of current business. Available at http://www.bea.gov/scb/account_articles/general/0100od/maintext.htm

CANOY, M. AND LERAIS, F., 2007: Beyond GDP: Overview paper for the Beyond GDP conference. Bureau of European Policy Advisers (BEPA), European Commission. Available at http://www.beyond-gdp.eu/download/bgdp-bp-bepa.pdf

COLLIGNON, S., 2006: The Lisbon Strategy, Macroeconomic Stability and the Dilemma of Governance With Governments. 2006. (unpublished). Available at: http://www.stefancollignon.de/PDF/New%20Lisbon%20strategy.pdf

CEC - COMMISSION OF THE EUROPEAN COMMUNITIES, 2005A: Directorate General for Economic and Financial Affairs, Stability and Growth pact, code of conduct: "Specifications on the implementation of the Stability and Growth Pact and Guidelines on the format and content of Stability and Convergence Programmes", endorsed by the ECOFIN Council on 11 October 2005. Available at http://ec.europa.eu/economy_finance/other_pages/other_pages12638_en.htm

CEC - COMMISSION OF THE EUROPEAN COMMUNITIES, 2005B: COM(2005) 330 final, Commission communication, Common Actions for Growth and Employment: The Community Lisbon Programme, [SEC(2005) 981], Brussels, 20.7.2005. Available at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2005:0330:FIN:EN:PDF

CEC - COMMISSION OF THE EUROPEAN COMMUNITIES, 2005C: SEC(2005) 161 final, Communication from Mr. Almunia to the members of the Commission, Sustainable

Development Indicators to monitor the implementation of the EU Sustainable Development Strategy, Brussels, 9.2.2005. Available at http://ec.europa.eu/sustainable/docs/sec2005_0161_en.pdf

CEC - COMMISSION OF THE EUROPEAN COMMUNITIES, 2005D: COM(2005) 24, Communication to the Spring European Council, Working together for growth and jobs A new start for the Lisbon Strategy, Communication from President Barroso in agreement with Vice-President Verheugen, Brussels, 02.02.2005. Available at http://ec.europa.eu/growthandjobs/pdf/COM2005_024_en.pdf

CEC - COMMISSION OF THE EUROPEAN COMMUNITIES, 2006: COM(2006) 816 final Part 1, Commission communication, Implementing the renewed Lisbon Strategy for growth and jobs - "A year of delivery", Brussels, 12.12.2006. Available at http://ec.europa.eu/growthandjobs/pdf/1206_annual_report_en.pdf

CEC - COMMISSION OF THE EUROPEAN COMMUNITIES, 2009A: COM(2009) 400 final, Commission Communication, Mainstreaming sustainable development into EU policies: 2009 Review of the European Union Strategy for Sustainable Development, Brussels, 24.7.2009. Available at http://ec.europa.eu/sustainable/docs/com_2009_400_en.pdf

CEC - COMMISSION OF THE EUROPEAN COMMUNITIES, 2009B: COM(2009) 433 final, Commission communication, GDP and beyond - Measuring progress in a changing world, Brussels, 20.8.2009. Available online at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2009:0433:FIN:EN:PDF (last accessed 10 November 2009)

DASGUPTA, P., 2001: Human Well-being and the Natural Environment, New York: Oxford University Press.

DIETZ, S. AND NEUMAYER, E., 2007: Weak and strong sustainability in the SEEA: Concepts and measurement. In *Ecological Economics* 61: 617-626

EEA - EUROPEAN ENVIRONMENT AGENCY, 2007: Technical paper: Accounting fully for ecosystem services and human well-being. EEA contribution to the Beyond GDP conference. Available at http://www.beyond-gdp.eu/download/bgdp-bp-eea.pdf

EEA - EUROPEAN ENVIRONMENT AGENCY, 2009: The time is ripe for green accounting. Available at http://www.eea.europa.eu/articles/the-time-is-ripe-for-green-accounting

EUROPEAN COUNCIL, 1997: Resolution of the European council on the Stability and Growth Pact Amsterdam, (97/C 236/01), 17 June 1997. Available at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31997Y0802(01):EN:html

EUROPEAN COUNCIL, 2001: SN 200/1/01 REV 1, Presidency conclusions of the Gothenburg European Council, 15 - 16 June 2001. Available at http://www.consilium.europa.eu/ueDocs/cms_Data/docs/pressData/en/ec/00200-r1.en1.pdf

EUROPEAN COUNCIL, 2005: Presidency conclusions of the Brussels European Council, 22 - 23 March 2005, Brussels, 23 March 2005. Available at http://www.consilium.europa.eu/ueDocs/cms_Data/docs/pressData/en/ec/84335.pdf

EUROSTAT, 2009: Annual national accounts. Available at http://epp.eurostat.ec.europa.eu/cache/ITY_SDDS/EN/nama_esms.htm

FERREIRA, S., HAMILTON, K. AND VINCENT, J. R., 2005: Genuine Savings: Leading Indicator of Sustainable Development? Economic Development and Cultural Change 53(3):737–54.

FERREIRA, S., HAMILTON, K. AND VINCENT, J. R., 2008: Comprehensive Wealth and Future Consumption: Accounting for Population Growth, The World Bank Economic Review 22(2): 233-248.

FREEMAN, D.G., 2000: Regional Tests of Okun's Law, *International Atlantic Economic Review* 6:3, 557-570.

GERMAN STATISTICAL OFFICE (NO DATE): Bruttoinlandsprodukt (BIP) . Available at http://www.destatis.de/jetspeed/portal/cms/Sites/destatis/Internet/DE/Presse/abisz/BIP,templateId=renderPrint.psml

GIOVANNINI, E., HALL, J., AND D'ERCOLE, M.M., 2007: Measuring Well-being and Societal Progress. Organisation for Economic Co-operation and Development. Background paper for the conference 'Beyond GDP', 19-20 November, Brussels. Available at http://www.beyond-gdp.eu/download/oecd_measuring-progress.pdf

GNÈGNÈ, Y., 2009: Adjusted net saving and welfare change. *Ecological Economics* 68: 1127-1139.

GOOSSENS, Y ET AL., 2007: Alternative progress indicators to Gross Domestic Product (GDP) as a means towards sustainable development. IP/A/ENVI/ST/2007-10. Study provided for the European Parliament's Committee on the Environment, Public Health and Food Safety. Available at http://www.beyond-gdp.eu/download/bgdp-bp-goossens.pdf

GROS, D. AND ROTH, F., 2008: The Post-Lisbon 2010 Process and the Key Role of Education in Employment and Competitiveness, Centre for European Policy Studies (CEPR).

Working Document 308/2008. Available at http://www.shop.ceps.eu/downfree.php?item_id=1768

HAMILTON, K., 2000: Genuine Saving as a Sustainability Indicator. World Bank Environment Department Papers 22744, Paper No. 77. The World Bank, Washington D.C.

HAMILTON, K., 2005: Testing Genuine Saving. World Bank Policy Research Working Paper 3577, April 2005. The World Bank, Washington D.C.

HAMILTON, K., AND HARTWICK, J. M., 2005: Investing Exhaustible Resource Rents and the Path of Consumption. Canadian Journal of Economics 38(2): 615-621.

HEAL, G., 2007: Environmental accounting for ecosystems. Commentary in *Ecological Economics* 61: 693-694

IISD - INTERNATIONAL INSTITUTE FOR SUSTAINABLE DEVELOPMENT, 2005: Sustainable Development Indicators: Proposals for the Way Forward. Available at http://www.iisd.org/pdf/2005/measure_indicators_sd_way_forward.pdf

KNOTEK, E.S., 2007: How Useful is Okun's Law. Economic Review. Federal Reserve Bank of Kansas City. 73-103. Available at http://www.kansascityfed.org/PUBLICAT/ECONREV/PDF/4q07Knotek.pdf

LANGE, G.-M., 2007: Environmental accounting: Introducing the SEEA-2003. *Ecological Economics* 61: 589-591.

MOLLGAARD, E., 2007: Accounting for the Environment - The European Development. Eurostat, Unit E-3: Environment statistics, European Commission. Background document for the conference 'Beyond GDP', 19-20 November, Brussels. Available at http://www.beyond-gdp.eu/download/bgdp-bp-mollgaard.pdf

OECD, 2002: The measure of GDP per capita in purchasing power standards (PPS): A statistical indicator tricky to interpret. Available at: http://www.oecd.org/dataoecd/48/44/1960906.doc

PEARCE, D. W., AND ATKINSON, G., 1993: Capital Theory and the Measurement of Sustainable Development: An Indicator of Weak Sustainability. *Ecological Economics* 8: 103-108.

PEDERSEN, O. G., AND DE HAAN, M., 2006: The System of Environmental and Economic Accounts – 2003 and the Economic Relevance of Physical Flow Accounting. *Journal of Industrial Ecology* 10(1-2): 19-42.

PILLARISETTI, J. R., 2005: The World Bank's Genuine Savings Measure and Sustainability. *Ecological Economics* 55:599–609.

SALTELLI, A., JESINGHAUS, J., AND MUNDA, G., 2007.:Well Being Stories. European Commission, Joint Research Centre, Ispra (Italy). Background document for the conference 'Beyond GDP', 19-20 November, Brussels. Available at http://www.beyond-gdp.eu/download/bgdp-bp-saltelli.pdf

SMITH, R., 2007: Development of the SEEA 2003 and its Implementation. *Ecological Economics* 61: 592-599.

STEINBUKA, I. AND WOLFF, P., 2007: Indicators and better policy-making: the case of sustainable development.

STIGLITZ, J.E., SEN, A. AND FITOUSSI, J.-P. 2008: Issues Paper of the Commission on the Measurement of Economic Performance and Social Progress. Available at http://www.stiglitz-sen-fitoussi.fr/documents/Issues_paper.pdf

STIGLITZ, J.E., SEN, A. AND FITOUSSI, J.-P. , 2009A: Report by the Commission on the Measurement of Economic Performance and Social Progress. Available at http://www.stiglitz-sen-fitoussi.fr/documents/rapport_anglais.pdf

STIGLITZ, J.E., SEN, A. AND FITOUSSI, J.-P., 2009B: Draft Summary: Provisional summary of the commission's work. CMEPSP, June 2009. Available at http://www.stiglitz-sen-fitoussi.fr/documents/draft_summary.pdf

SUSTAINABLE EUROPE RESEARCH INSTITUTE (SERI), 2007: Virtual exhibition of sustainable development indicators: Factsheets of indicators. Beyond GDP conference, 19 & 20 November 2007, Brussels. avaiable at http://www.beyond-gdp.eu/factsheets.html

UNITED NATIONS, 2003: Studies in methods – Handbook of national accounting: Integrated environmental and economic accounting 2003. CEC, IMF, OECD, United Nations, and World Bank. United Nations: New York. Available at: http://unstats.un.org/unsd/envAccounting/seea2003.pdf

UNITED NATIONS, 1993A: SNA Handbook on Integrated Environmental and Economic Accounting, Statistical Office of the United Nations, Series F, No. 61, New York.

UNITED NATIONS, 1993B: System of national accounts 1993. Series F, No. 2, Rev. 4. CEC, IMF, OECD, World Bank, and United Nations. United Nations: New York.

UNSD - UNITED NATIONS STATISTICS DIVISION, 2009: United Nations Statistical Division Environmental Accounting. Available at http://unstats.un.org/unsd/envaccounting/seearev/

UNDSD - UNITED NATIONS DIVISION OF SUSTAINABLE DEVELOPMENT, 2007: Indicators of Sustainable Development: Guidelines and Methodologies. 3rd Edition. UN Division

for Sustainable Development, Department of Economic and Social Affairs, United Nations, New York. Available at www.un.org/esa/sustdev/natlinfo/indicators/guidelines.pdf

WALKER, B.H. AND PEARSON, L., 2007: A resilience perspective of the SEEA. *Ecological Economics* 61: 708-715.

WESSELINK, B., BAKKES, J., BEST, A., HINTERBERGER, F., AND TEN BRINK, P., 2007: Measurement Beyond GDP. Background document for the conference 'Beyond GDP', 19-20 November, Brussels. Available at http://www.beyond-gdp.eu/download/bgdp-bp-mbgdp.pdf

WHITE, S., AND ZWIRNER, O., 2007: The use of indicators in the European Commission. Directorate-General Environment, Unit Sustainable Development and Economic Analysis, European Commission. Available at http://www.beyond-gdp.eu/download/bgdp-bp-white.pdf

WORLD BANK, 2009: Adjusted Net Saving (Genuine Saving). Available at http://go.worldbank.org/EPMTVTZOM0

Technical Annex: RACER Criteria and Subcriteria

The following lists the RACER analysis sub-criteria developed by Ecologic to fine-tune the indicator assessment.

Relevant

Policy support, identification of targets and gaps

The indicator/methodology…

- Relates to existing EU-specific policy objectives?
- Provides guidance in monitoring, strategic policy making and/or target setting?
- Identifies gaps between the current situation and specified targets?

- Offers adequate and early warning to guide policy action?
- Reacts to short-term changes that can (among other things) show whether policies are having an effect?

Identification of trends

The indicator/methodology…

- Tracks change in time?

Forecasting and modelling

The indicator/methodology…

- Allows forecasting of future environmental impacts
- Is suitable for modelling of the impact of different potential policies or of technology progress and/or change of consumption patterns?
- Can function as an early warning indicator?

Scope/levels of application

The indicator/methodology…

- Informs about the effective levels of application (e.g., local, national, international)?
- Can be disaggregated (spatially, by product, by industry or by ecosystem type).

Function- and needs-related analysis

The indicator/methodology…

- Permits comparisons among material and energy resources in terms of their functions and competition in the real world?
- Permits comparisons of different ways of fulfilling basic human needs (housing, mobility, food, etc.) with regard to their resource-use implications?

Accepted

Stakeholder acceptance

The indicator/methodology…

- Has an underlying rationale and meaning that is easily understood and accepted?

Credible

Unambiguous

The indicator/methodology…

- Sends an unambiguous message to political decision-makers and general public?

Transparency of the method

The indicator/methodology…

- Fully discloses the underlying data and calculation methods and is interpretable and reproducible?

Easy

Data availability

The indicator/methodology…

- Does not require inputs of data that are overly excessive, expensive or onerous to collect, or that cannot be properly measured?

- Requires only data that are already available in electronic form?

Technical feasibility

The indicator/methodology…

- Is simple enough to be calculated using software and expertise appropriate to the scale of application and the typical capabilities of the institution doing the calculations?

Complementarity and integration

The indicator/methodology…

- Is complementary to the remaining methodologies/indicators that are being assessed?
- Allows further integration of the methodology/indicator with the remaining methodologies/indicators?

Robust

Defensible theory

The indicator/methodology…

- Is based on sound theory?
- Avoids double counting or omissions of resources used?
- Consistent in its units of measurement?
- Relies on assumptions that are clearly stated and reasonable and does not require the use of ill-defined or poorly quantified parameters?
- Avoids use of subjective factors to weight different components?

Sensitivity

The indicator/methodology…

- Changes rapidly enough with respect to input parameters to pick up policy-significant changes and can detect non-linearities, discontinuities and thresholds?

Data quality

The indicator/methodology…

- Uses data of sufficient quality?

Reliability

The indicator/methodology…

- Is reliable in terms of its accuracy, repeatability, and the clear specification of protocol and formulas used in the calculations?

Completeness

The indicator/methodology…

- Is complete in terms of the objective it is assessing?

- Avoids shifting burdens from one problem/impact to another (e.g., from climate change to nuclear risks) or from one region to another (e.g., relocation of production may shift environmental burden away from the place of consumption)?