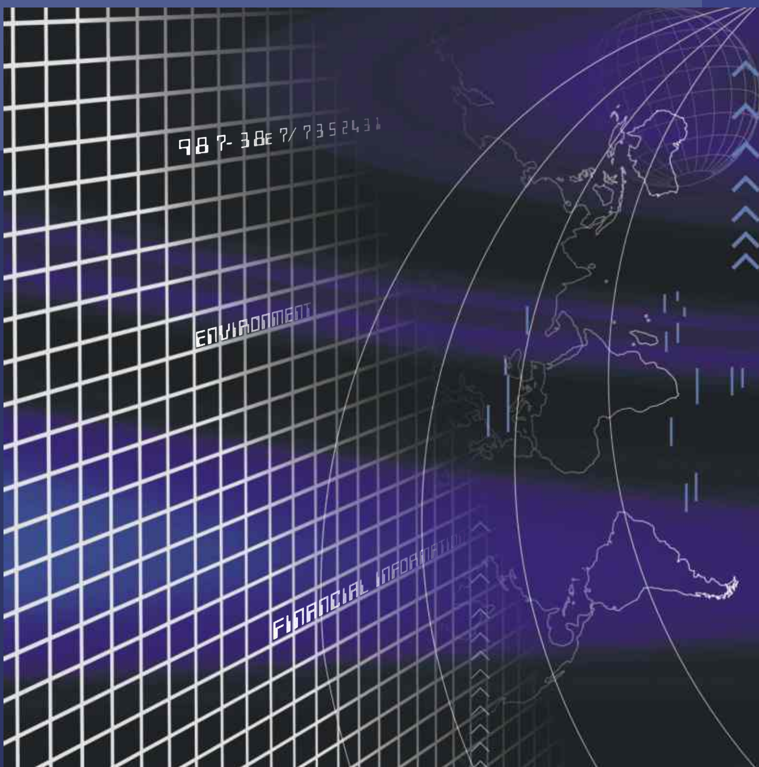
UNITED NATIONS CONFERENCE ON TRADE AND DEVELOPMENT

A Manual for the Preparers and Users of Eco-efficiency Indicators



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A Manual for the Preparers and Users of Eco-efficiency Indicators

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NOTES

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PREFACE

The United Nations' work on transparency and accountability originated in 1975 when the former UN Commission on Transnational Corporations became concerned about the lack of meaningful disclosure by transnational corporations in their financial statements. It found that the financial information provided by transnational corporations was not reliable, transparent or comparable. In order to promote the harmonization of financial information and meaningful disclosure to all users of financial statements, the Economic and Social Council created the Intergovernmental Working Group of Experts on International Standards of Accounting and Reporting (ISAR).

In 1989 ISAR took up the topic of corporate environmental accounting. The Group soon discovered in its first survey that there were no national accounting standards specific to environmental information disclosure. Furthermore, some CEOs believed that environmental information was not necessary for a true and fair view of the enterprise's performance or that it was too difficult to obtain. To meet this obvious need for guidance, ISAR issued its first recommendations for environmental disclosure in financial statements in 1991.

This guidance was soon followed by intense study and analysis by national standard-setters. In 1998 ISAR revisited the issue of environmental disclosure and expanded its recommendations based on emerging best practices. Its objective in issuing a new guideline – Accounting and Financial Reporting for Environmental Costs and Liabilities – was to ensure that different standard-setters did not adopt different solutions for the same problems.

However, it is clear that the conventional accounting model is not able to assess an enterprise's environmental performance and its impact on financial performance to the degree desired by all stakeholders. This is because the conventional model was developed to provide information only on financial position and performance. However, it is obvious that in the post-Enron era, stakeholders want non-financial information covering the enterprise's environmental and social performance, as well as information on its corporate governance structures and procedures. The environmental world summits in Rio (1992) and Johannesburg (2002) have shown that the business community has become committed to the concept of sustainable development and to improving its environmental performance. On the other hand, various stakeholders are demanding that enterprises report on these improvements. In particular, the financial community is concerned about how environmental performance affects the financial results of an enterprise.

This concern about sustainable development is now complemented in the post-Enron era by corporate concern about "sustainable value" or "sustainable business". To achieve sustainable development, sustainable value or sustainable business, enterprise management must take into account the impact of their performance on their employees, their customers, their suppliers and the community, including its environment.

This manual presents the results of ISAR's work to extend the conventional accounting model and to link environmental performance with financial performance. The precise correlation between improved environmental performance of an enterprise and its bottom line is extremely difficult to prove because of the many factors that can affect profits. However, the concept of eco-efficiency, where increased profits are achieved under conditions of declining environmental impact, demonstrates such a link. Despite the practical usefulness of eco-efficiency indicators, their construction and use are highly problematic. This manual presents a method by which environmental and financial performance indicators can be used together to measure an enterprise's progress in attaining eco-efficiency or sustainability. The manual provides detailed explanations and examples for the preparers and users of eco-efficiency indicators so that they can produce internally consistent environmental and financial information, thus improving the quality of environmental reporting and stakeholder satisfaction.

Rubens Ricupero
Secretary-General of UNCTAD

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ABBREVATIONS

eq.	equivalent
GWP	global warming potential
IAS	International Accounting Standards
IASB	International Accounting Standards Board
IPCC	Intergovernmental Panel on Climate Change
ISAR	Intergovernmental Working Group of Experts on International Standards of Accounting and Reporting
ODS	ozone-depleting potential
OECD	Organisation for Economic Co-operation and Development
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
UNEP	United Nations Environment Programme
WBCSD	World Business Council for Sustainable Development

I. INTRODUCTION

I.A. Overview

1. This manual is a guide for users and preparers of eco-efficiency indicators[1] (see Box 1). The main objective is to describe the method that enterprises can use to provide information on environmental performance vis-à-vis financial performance in a systematic and consistent manner over periods of time. This manual complements two previous UN reports and should be seen as a series.[2]

Box 1. The Concept of Eco-efficiency

Investors increasingly require that companies pursue eco-efficient strategies that reduce the damage caused to the environment while increasing or at least not decreasing (shareholder) value. The aim of environmentally sound management is to increase eco-efficiency by reducing the environmental impact while increasing the value of an enterprise (Schaltegger/Sturm 1989). The World Business Council for Sustainable Development (WBCSD) describes how eco-efficiency is achieved: "Eco-efficiency is reached by the delivery of competitively priced goods and services that satisfy human needs and bring quality of life, while progressively reducing ecological impacts and resource intensity…" The WBCSD includes a clear target level: An eco-efficient state is reached when economic activities are at a level "…at least in line with the earth's estimated carrying capacity". (WBCSD 1996)

An eco-efficiency indicator is the ratio between an environmental and a financial variable. It measures the environmental performance of an enterprise with respect to its financial performance. The problem with constructing eco-efficiency indicators is that there are no agreed rules or standards for recognition, measurement and disclosure of environmental information either within the same industry or across industries. Most importantly, there are no rules for consolidating environmental information for an enterprise or for a group of enterprises so that it can be used together and in line with the enterprise's financial items.

2. The purpose of the manual is threefold:

(a) To give guidance on how to define, recognize, measure and disclose environmental and financial information as specified within the traditional accounting and reporting frameworks (Box 2);

(b) To improve and harmonize the methods used so that enterprises are able to report eco-efficiency indicators in a standardized format so that they are meaningful to decision makers and can be compared across enterprises;

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1 The term and concept of eco-efficiency was developed in the late 1980s. It was first described in a scientific publication back in 1989 (see Schaltegger/Sturm 1989).

2 Accounting and Financial Reporting for Environmental Costs and Liabilities (1999) and Integrating Environmental and Financial Performance at the Enterprise Level (2000).

(c) To complement and support existing reporting guidelines (e.g. the UN Sustainability Reporting Guidelines developed by the Global Reporting Initiative (GRI));

Box 2. Accounting and Reporting Framework

An accounting framework describes an interrelated system that consists of different financial statements (such as a balance sheet, income statement and cash flow statement). It covers issues of recognition, measurement and disclosure of information. A reporting framework — such as the Sustainability Reporting Guidelines of the Global Reporting initiative (GRI 2001) — provides additional guidance on the issues to be reported, the structure and the format of the report. This manual therefore covers the technical issues of recognition, measurement and disclosure of environmental transactions and variables. It also suggests the issues to be reported and the format and structure of disclosure.

3. As an attempt to harmonize the provision of eco-efficiency information across the globe, the manual follows the logic of the widely accepted International Accounting Standards (IAS). In particular the framework draws directly from the International Accounting Standards Board (IASB) framework (IASB 2002) and is adapted to report environmental performance vis-à-vis financial performance of the reporting entity.

4. This manual will enable enterprises to report their eco-efficiency performance for the five generic environmental issues below:

(a) Water use;
(b) Energy use;
(c) Global warming contribution;
(d) Ozone depleting substances;
(e) Waste.

5. These indicators represent a basic set upon which an enterprise could or should report. They were chosen by ISAR because they address worldwide problems as reflected in international agreements or protocols. Furthermore they can be used by all enterprises across all sectors. Hence they are generic rather than sector-specific indicators.

6. The above list is basically open-ended and should be adapted whenever new environmental issues evolve and/or existing environmental problems are reassessed in the light of new scientific and/or social knowledge. Managers are encouraged to include additional eco-efficiency indicators in their disclosure as they become relevant and material to understanding and evaluating an enterprise's performance in its sector.

7. In addition to the above environmental issues, the manual presents the accounting treatment of the financial item used for constructing eco-

efficiency indicators. It deals with issues of consolidation of financial and environmental data for the enterprise as a whole.

8. This guidance can serve as a management tool for the following:

(a) Benchmarking;
(b) Assessing acquisitions and divestments;
(c) Assessing the impact of changes in the product line of an enterprise.

I.B. Rationale for an Accounting Framework for Eco-efficiency Reporting

9. This section aims to demonstrate the necessity and usefulness of a conceptual framework for eco-efficiency reporting by discussing some issues and frequently asked questions.

I.B.1. Objectives

10. The basic objective of financial accounting is to provide information that is useful to a wide range of users in making economic decisions. A secondary objective is to show the results of the stewardship of management or the accountability of management for the resources entrusted to it (IASB Framework, paragraphs 12 and 14).

11. Users must be able to compare the eco-efficiency statements of an enterprise over time so that they can identify trends in its eco-efficiency position and performance. Users must also be able to compare the eco-efficiency statements of different enterprises. Disclosure of accounting policies is essential for comparability (IASB Framework, paragraphs 39-42).

12. The basic objective of ISAR in developing guidelines and manuals for eco-efficiency indicators is to provide information that is useful to a wide range of users in making decisions and for the accountability of management for resources entrusted to it.

I.B.2. Consensus and Quality of Information

13. The most essential aspect of a guideline is its acceptance by the main stakeholder groups involved. If these groups do not accept a guideline or standard, it will not be applied.[3] Acceptance can be gained by integrating the views and values of all important target groups.

14. If there is to be consensus on a framework, it must attain a certain level of quality. But quality has its price – the higher the quality of information, the more costly it is. All involved parties should therefore agree on the degree of

[3] A standard, on the other hand, can also be mandated by the accounting standard-setting bodies or other regulators and would then have to be applied, irrespective of agreement by the parties involved.

quality the required information should have. The description and definition of the degree of quality is an integral part of the conceptual accounting framework.

15. The characteristics that make information useful to users are termed qualitative characteristics. The four main qualitative characteristics are understandability, relevance, reliability and comparability (see II.F).

I.B.3. Duty of Users

16. Qualitative characteristics are important because they also address the requirements of users. Often it is argued that information about special issues should be suppressed, either because no user would be able to understand it correctly or because it would be too voluminous to describe. Consequently, some disclose such information, while others do not.

17. Qualitative characteristics clearly stipulate the duty of users to understand and to undertake efforts to understand information even if it might be complex. Thus, qualitative characteristics balance the requirements of users and preparers in such a way as to be cost effective (see II.F.5).

I.B.4. Financial Accounting Framework as a Starting Point

18. Accounting for eco-efficiency should benefit from the experience of financial accounting and not reinvent the wheel. Since a conceptual framework and standards have been developed on an international level for financial accounting, it is proposed to use these as a starting point for eco-efficiency accounting. There are several reasons for this:

    (a) Eco-efficiency indicators link environmental and financial items, and eco-efficiency indicators thus use data from both environmental and financial accounting systems. Accordingly, the applied conceptual frameworks for ecological and financial accounting have to be comparable if environmental and financial data are to be combined to produce eco-efficiency indicators. More explicitly, the data have to be derived from the same reporting entity and not different subsets of that entity. This issue will be discussed further in the consolidation section.

    (b) A general framework improves the quality and consistency of eco-efficiency statements considerably. Where appropriate, industry- and region-specific environmental aspects and issues need to be considered. The general framework also provides guidance when periodically reviewing existing and newly developed guidelines.

    (c) The quality of decision-making (by enterprise directors, investors and financial analysts) can be improved by linking environmental and financial items. For instance, energy requirement per unit of value added provides a good indication of the impact of an energy tax on an enterprise. Since the main objective of financial accounting is to improve the quality of decision making, the financial accounting framework can serve as a valuable starting point in formulating the respective systems for environmental elements and items.

II. CONCEPTUAL ACCOUNTING AND REPORTING FRAMEWORK FOR ECO-EFFICIENCY REPORTING

II.A. Introduction to the Framework

19. This section introduces a conceptual accounting and reporting framework (framework) for eco-efficiency reporting. This framework will follow a similar approach in reporting financial information as specified by International Accounting Standards.

II.B. The Accounting Framework for Eco-efficiency

II.B.1. Purpose and Status

20. The purpose of this conceptual framework for eco-efficiency reporting is to improve and harmonize the methods used for definition, recognition, measurement and disclosure of eco-efficiency information related to events and activities of an enterprise with a view to promoting comparability between reporting organizations.

21. This conceptual framework also provides guidance in the development of future eco-efficiency indicators (e.g. additional industry- or region-specific indicators) and in the review of existing guidelines on eco-efficiency indicators.

22. This framework does not provide standards for eco-performance. However eco-efficiency indicators will provide a useful basis for benchmarking.

II.B.2. Scope

23. The framework deals with:

    (a) The objectives of eco-efficiency indicators;
    (b) Elements and items of an eco-efficiency statement;
    (c) Qualitative characteristics that determine the usefulness of eco-efficiency indicators;
    (d) The definition, recognition and measurement of environmental and financial items used in eco-efficiency accounting and reporting.

24. The framework is concerned with environmental and related financial information on the eco-efficiency of an enterprise. Such information is prepared and presented annually and directed towards the common information needs of a wide range of users (see IASB Framework, paragraph 6).

25. This framework was developed primarily for business organizations to provide information on the eco-efficiency of their enterprises. However, the public sector and non-profit organizations can also use the framework.

II.B.3. Users and Their Information Needs

26. The users of eco-efficiency indicators include present and potential investors, employees, lenders, other trade creditors, suppliers' customers, Governments and their agencies, and the general public (see IASB Framework, paragraph 9).

27. Most users have to rely on environmental and financial items as their major source of environmental information, and such information should therefore be prepared and presented with their needs in view (see IASB Framework, paragraph 6).

II.C. Objectives of Eco-efficiency Indicators

II.C.1. Provide Information

28. The objective of eco-efficiency reporting is to provide information on the environmental performance of an enterprise with respect to its financial performance (financial performance/environmental performance).

II.C.2. Improve Decision-Making

29. Eco-efficiency information complements financial statements in order to enhance the quality of decision-making.[4] The information is useful to a wide range of users in making economically and environmentally sound decisions and in evaluating the impact of their decisions. Such information is also necessary for the accountability of management for the use of natural resources entrusted to it (see IASB Framework, paragraphs 12 and 14).

II.C.3. Complement Financial Statements

30. Eco-efficiency data can also be used to forecast the impact of current and upcoming environmental issues on future financial performance.

[4] Although financial statements support the quality of decision-making, standard-setters are well aware that financial statements are not sufficient. Two main shortcomings are mentioned in the 1983 version of the framework of the International Accounting Standards Committee (the predecessor of the International Accounting Standards Board IASB): "... financial statements do not provide all the information that users may need to make economic decisions since they largely portray the financial effects of past events and do not necessarily provide non-financial information" (IASB Framework, paragraph 13). Empirical evidence suggests that there is a strong link between eco-efficiency and future cash generation.

31. Information about environmental performance vis-à-vis financial performance is useful in determining the ability of an enterprise to adapt to changes in the environment in which it operates.

II.D. Elements and Items of an Eco-efficiency Statement

32. Eco-efficiency statements portray environmental and financial effects of transactions and activities by grouping these effects into broader classes according to their environmental and financial characteristics.

33. The following definitions refer to the hierarchy of information within an eco-efficiency statement:

(a) Element

Elements are the broad areas or groupings of financial and/or environmental issues of concern to stakeholders (e.g. global warming contribution, energy requirement, waste, assets, liabilities, equity, income and expense, etc.).[5]

(b) Item

An item or a group of items is information that is related to a specific element (e.g. a specific greenhouse gas, an energy source used, a type of waste, sales, cost of goods and services purchased). A given element may have several items or a group of items.[6]

(c) Indicator

An indicator is a specific measurement of an individual element that is used to track and demonstrate performance related to the element via recognition and measurement of items. A given element may have several indicators based on different items. To normalize a dynamic development over time, indicators use a reference item to exclude effects of quantitative changes in activities and to make them comparable; examples include "per tonne", "per unit of net value added" or "per unit of sales". As per definition, eco-efficiency indicators are set in relation to a financial item, i.e. indicators are ratios composed of an environmental item divided by a financial item.

[5] Note: The Global Reporting Imitative (GRI 2001) uses the term "category". As we do not see any reason to change accepted terminology, we prefer to stick to the terms and concepts already in use in international accounting standards.

[6] Note: The Global Reporting Imitative (GRI 2001) uses the term "aspect". As we do not see any reason to change accepted terminology, we prefer to stick to the terms and concepts already in use in international accounting standards.

34. This framework and the accompanying guidance recommend[7] that all enterprises report their eco-efficiency at least with respect to the following environmental elements:

    (a) Energy use;
    (b) Water use;
    (c) Global warming contribution;
    (d) Contribution to ozone depletion;
    (e) Waste.

35. Enterprises are encouraged to define industry- or region-specific environmental elements and associated guidance. When doing so, it is recommended to use this framework, including the guidance for the above elements, as a starting point for the development of any additional guidance.

36. For the purpose of this manual, environmental information means any data on an item that relates to one of the above environmental elements, while financial information means any data on an item that relates to assets, liabilities, equity, income and/or expenses. Environmental information is measured in physical units, while financial information is measured in monetary units.

II.E. Underlying Assumptions

II.E.1. Reporting Entity and the Principle of Congruity

37. An eco-efficiency statement will clearly define the reporting entity in terms of which sites, activities and legal entities are included or excluded and how and to what extent this is done.

38. For the purpose of eco-efficiency statements, the same concepts and criteria used in financial accounting and reporting will be applied when defining the reporting entity for the recognition and measurement of environmental elements and items and the disclosure of such information.

39. As eco-efficiency indicators set an environmental item (e.g. energy use) in relation to a financial item (e.g. net value added), the definition of the reporting entity for both these items must be congruent, in other words they must represent the same activities of the same entity.

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[7] This recommendation is based on the identified environmental problems presented in the UNCTAD conceptual paper (UNCTAD 2001). The criteria for the selection were: (1) the environmental indicator must address a worldwide environmental problem; (2) the environmental indicator must be applicable to all industries across all sectors; (3) the environmental indicator must link an environmental problem at the macro level to activities of an enterprise at the micro level; and (4) the environmental problem measured by the indicator must have an impact on the financial performance of an enterprise. See also Sturm/Müller 2001.

40. It is up to the reporting entity to include additional information, which expands the definition of the reporting entity up- or downstream in the value chain. If this is done the enterprise will expand the boundaries in terms of environmental data and in terms of financial data to maintain congruity (see Box 3).

II.E.2. Reporting Scope

41. An eco-efficiency statement will make clear the scope of activities reported and provide explanations for any restrictions in reporting scope. Ideally, a reporting entity will cover the impacts of its activities on at least the five environmental elements set out in paragraph 34.

II.E.3. Accrual Basis

42. Reportable resource uses, emissions, environmental impacts, events and activities will be recognized when they occur and will be recorded and reported in the periods to which they relate (see IASB Framework, paragraph 22).

43. Eco-efficiency indicators prepared on an accrual basis inform users not only of past environmental performance vis-à-vis financial performance but also of the potential impact that a change in environmental legislation has on an enterprise's future cash flows. Hence they provide information that is useful to users to make informed economic and environmental decisions.

II.E.4. Going Concern

44. The published data should reflect the assumption that the reporting entity is expected to continue operations into the foreseeable future.

45. If the enterprise either intends or needs to liquidate or curtail materially the scale of its operations, the eco-efficiency data may have to be prepared on a different basis and, if so, the basis used should be disclosed (see IASB Framework, paragraph 23).

46. The published report should also include the management's assessment of the consequences of moving towards modes of production and/or service delivery compatible with sustainability (GRI 2001).

Box 3. Principle of Congruity and the Life-Cycle Approach

Most environmental accounting and reporting guidelines developed by environmentalists and economists take a so-called life-cycle approach, meaning that the reporting entity should include processes up- and downstream in the value chain (e.g. the Guideline on Sustainability Reporting published by the Global Reporting Initiative). This framework and guidance clearly takes a different stand on this aspect. It follows the approach used in financial accounting, since environmental and financial data must be consistent, that is they must match the transactions of the same entities included in a consolidated financial statement. If an enterprise expands its eco-efficiency reporting to include the life cycle of its products and services, it must make sure that, if the environmental item includes activities up- and/or downstream, the financial item used as a reference figure also covers these activities. Otherwise the two items are not congruent - they do not cover the same activities - and therefore the eco-efficiency figure is inconsistent and the information worthless.

On the other hand, if an enterprise chooses sales as a reference figure, it must be aware that its own sales also include part of the sales of its suppliers; what the company calls purchase cost is sales from the supplier's perspective. Consequently if sales are used as a reference item and the environmental item should cover the same activities, then the relevant environmental information of the suppliers linked to the reporting entities' purchases must also be included. To avoid these problems with sales as a reference figure and to arrive at a consistent eco-efficiency indicator, a company must deduct the cost of goods and services purchased from its sales figures. That way the financial figure represents economic activities of the reporting entity only. This in turn makes it possible to restrict the environmental data to the reporting entities' own resource consumption, emissions or waste production.

These approaches illustrate that including up- and downstream information is highly impractical. Especially in the case of an annual company report, it means that the expansion has to be done for all the company's activities, products and services and therefore for all of its suppliers and customers as well.

Life-cycle approaches provide highly valuable information but are too costly and impractical to use on larger entities with many activities, products and services on a regular basis. The scope and the objective of life-cycle approaches are to analyse specific products and to optimize these products throughout the value chain. This is clearly not the intent of an annual report, which describes the eco-efficiency of an enterprise.

II.F. Qualitative Characteristics

47. Qualitative characteristics are attributes that make the information provided in eco-efficiency statements useful to users.

48. The four principal qualitative characteristics are

    (a) Understandability;
    (b) Relevance;
    (c) Reliability; and
    (d) Comparability (see IAS framework, paragraph 24).

49. The application of these four qualitative characteristics normally results in eco-efficiency information that conveys a true and fair view of the eco-efficiency performance of an enterprise (see IASB Framework, paragraph 46).

II.F.1. Understandability

50. Information must be understandable to users. For this purpose, users are assumed to have reasonable knowledge of business environmental issues and accounting and a willingness to study the information with reasonable diligence.

51. However, information about complex environmental matters which is relevant to the decision-making needs of users should be included and not excluded merely on the grounds that it may be too difficult for certain users to understand (see IASB Framework paragraph 25).

II.F.2. Relevance and Materiality

52. Eco-efficiency information is relevant when it influences the decisions of users in the following manner:

    (a) By helping them evaluate past, present or future events (see IASB Framework, paragraph 26),

    (b) Or by confirming or correcting their past evaluations (see IASB Framework, paragraph 26).

53. The predictive and confirmatory roles of eco-efficiency information are interrelated. For example, information about the current level and structure of environmental performance has value to users when they endeavour to predict the ability of an enterprise to take advantage of opportunities and its ability to react in adverse situations. The same information plays a confirmatory role in respect of past predictions about, for example, environmental objectives and targets (see IASB Framework, paragraph 27).

54. The relevance of eco-efficiency information is affected by its nature and materiality (see IAS framework, paragraph 29). Information is material if its omission or misstatement could influence the decisions of users taken on the basis of eco-efficiency statements. Materiality depends on the size of the item or error judged in the particular circumstances of its omission or misstatement. Thus, materiality provides a threshold or cut-off point rather than being a primary qualitative characteristic that information must have if it is to be useful (see IASB Framework, paragraph 30).

II.F.3. Reliability

55. Eco-efficiency information has the quality of reliability when it is free from material error and bias and can be depended upon by users to represent faithfully what it either purports to represent or could reasonably be expected to represent (see IASB Framework, paragraph 31).

56. To be reliable, eco-efficiency information must represent faithfully the activities and other events of the reporting entity. Thus, for example, the aggregated emissions of global warming gases should represent faithfully the contribution of the reported activities/transactions of an enterprise to the problem of global warming (see IASB Framework, paragraph 33).

57. For eco-efficiency information to be reliable, it is necessary that activities and other events are accounted for and presented in accordance with their substance and environmental reality and not according to their legal form. This is known as the "substance over form" principle. The substance of activities or other events is not always consistent with what is apparent from their legal or contrived form. For example, an enterprise may report very low global warming emissions based on the substances listed under the Kyoto protocol but emit major amounts of other non-listed global warming gases. For eco-efficiency information to be reliable, these emissions have to be accounted for (see IASB Framework, paragraph 35).

58. Eco-efficiency information must be neutral, that is free from bias. Eco-efficiency information is not neutral if, by the selection or presentation of information, it influences a decision or judgement in order to achieve a predetermined result or outcome (see IASB Framework, paragraph 36).

59. The preparers of eco-efficiency information do, however, have to contend with the uncertainties that inevitably surround many events and circumstances. Such uncertainties are recognized by disclosing their nature and extent and by exercising prudence in the preparation of the eco-efficiency information (see IASB Framework, paragraph 37).

60. The eco-efficiency information must be complete within the bounds of materiality and cost. An omission can cause information to be false or misleading and thus unreliable and deficient in terms of its relevance (see IASB Framework, paragraph 38).

II.F.4. Comparability

61. Users must be able to compare the eco-efficiency information of an enterprise over time in order to identify trends in its eco-efficiency performance. Users must also be able to compare the eco-efficiency information of different enterprises in order to evaluate their relative eco-efficiency performance (benchmarking). Hence, the measurement and display of the environmental effect of like activities and other events must be carried out in a consistent way throughout an enterprise and over time for that enterprise and in a consistent way for different enterprises. Because users wish to compare the eco-efficiency information over time, it is important that the eco-efficiency information show consistent information for the preceding periods (see IASB Framework, paragraph 39 and 42).

62. Comparability implies that users must be informed of the policies and methodologies employed in the preparation of eco-efficiency information, any changes in these policies/methodologies, and the effects of such changes.

Users need to be able to identify differences between the policies and methodologies for like activities and other events used by the same enterprise from period to period and by different enterprises (see IASB Framework, paragraph 40).

63. Comparability implies that, for example, when new scientific knowledge is developed which leads to a change in methodology applied to environmental information, this should lead to a re-evaluation and recalculation of eco-efficiency information disclosed in the past (assuming that past values are available). As a minimum, the year used for comparison (which is normally the last year) should be recalculated. But it could also be any defined base year, from which data is recalculated.

64. It is inappropriate for an enterprise to continue reporting in the same manner on a transaction or other event if the policy adopted is not in keeping with the qualitative characteristics of relevance and reliability. It is also inappropriate for an enterprise to leave its reporting policies unchanged when more relevant and reliable alternatives exist. Thus, the need for comparability should not be confused with absolute uniformity (see IASB Framework, paragraph 41).

II.F.5. Balancing Qualitative Characteristics

65. As there are trade-offs between different qualitative characteristics it is often necessary to balance the four qualitative characteristics. Generally, the aim is to achieve an appropriate balance among the characteristics in order to meet the objectives of eco-efficiency reporting. The relative importance of the characteristics in different cases is a matter of professional judgement (see IASB, Framework paragraph 45).

66. Preparers may need to balance the relative merits of timely reporting and the provision of reliable information. To provide information on a timely basis it may often be necessary to report before all aspects of a transaction or other event are known, thus impairing reliability. Conversely, if reporting is delayed until all aspects are known, the information may be highly reliable but of little use to users who have to make decisions in the interim. In achieving a balance between relevance and reliability, the overriding consideration is how best to satisfy the decision-making needs of users (see IASB Framework, paragraph 43).

67. An enterprise has, in the interest of both users and the enterprise, to balance benefit and cost. The benefits derived from information should exceed the cost of providing it. The evaluation of benefits and costs is, however, substantially a judgemental process. Furthermore, the costs do not necessarily fall on those users who enjoy the benefits (see IASB, Framework paragraph 44).

II.F.6. True and Fair View/Fair Presentation

68. Eco-efficiency statements can be seen as presenting fairly the eco-efficiency position, performance and changes in the eco-efficiency position of an enterprise. The application of the principal qualitative characteristics and of appropriate guidelines normally results in eco-efficiency statements that convey what is generally understood as a true and fair view of, or as presenting fairly, such information.

II.G. Recognition and Measurement of Items

II.G.1. Recognition

69. Recognition is the process of incorporating an environmental or financial item that satisfies the criteria for recognition set out in paragraph 70. It involves the depiction of the item in words and by an amount in physical or monetary units (see IASB Framework, paragraph 82).

70. An item can be incorporated if the item has a value that can be measured in physical or monetary units with reliability.

71. In many cases, a value must be estimated; the use of reasonable estimates is an essential part of the preparation of eco-efficiency information and does not undermine their reliability. When, however, a reasonable estimate cannot be made, the item is not recognized. Where relevant it should be disclosed (see IASB Framework, paragraph 86). This is appropriate when knowledge of the item is considered to be relevant to the evaluation of the eco-efficiency position, performance and changes in position of an enterprise by the users of eco-efficiency statements (see IASB Framework, paragraph 88).

II.G.2. Measurement

72. Measurement is the process of determining the physical or monetary value at which an item is to be recognized.

73. A number of different measurements, calculations and estimations are employed to different degrees and in varying combinations:

    (a) Metered value

    A metered (or gauged) value is a value that is scaled by means of a balance or other instrument.

    (b) Estimated value

    An estimated value is a value based on common practice and applied technology, where an average level of technology is assumed. If other levels of technology are used for the estimate, this should be disclosed.

(c) Calculated value

A calculated value is based on (user-) defined algorithms. The inputs into the calculation are values of different quality levels (e.g. metered, estimated) and/or defined conversion factors.

(d) Empirical value

An empirical value is a value based on empirical studies/research and scientific evidence.

(e) Reference value

A reference value is a value used to normalize a dynamic development. Through normalization, results for different entities with different levels of activities and dynamics are transformed into the same unit, so they become comparable.[8]

(f) Conversion factor

A conversion factor is a consensus value based on generally accepted scientific standards, concepts or models.

8 Example: In the year 2000 company A used 1,000 m^3 water, and in 2001 it used 1,100 m^3. To judge the eco-efficiency of that company, we need to divide the water use by a figure that represents the level of activity. One possibility is sales, another value added. Assuming sales were 100 in the year 2000 and 110 in 2001, the normalized eco-efficiency figure for both years is equal.

III. GUIDELINES

III.A. General Scope

74. This manual assesses the impacts of the following environmental variables:

    (a) Water use (I.A);
    (b) Energy use (III.C);
    (c) Global warming contribution (III.D);
    (d) Ozone-depleting substances (III.E);
    (e) Waste (III.F).

75. The manual describes the following financial items and issues relevant for eco-efficiency indicators:

    (a) Value added and net value-added, revenue, purchased goods and services (III.G)
    (b) Consolidation (I.A)

76. The manual contains a methodology for calculating, recognizing, measuring and disclosing the following five indicators:

    (a) Water consumption per net value added;
    (b) Global warming contribution per unit of net value added;
    (c) Energy requirement per unit of net value added;
    (d) Dependency on ozone-depleting substances per unit of net value added;
    (e) Waste generated per unit of net value added.

    All figures refer to a calendar year.

77. The above list is basically open-ended and should be adapted whenever new environmental issues evolve and/or existing environmental problems are reassessed by new scientific and/or social knowledge. The list can also be expanded to cover the particular industry sector. It would be more appropriate for industry associations to specify sector-specific indicators because they are best positioned to obtain industry consensus.

78. Companies are encouraged to develop additional indicators (e.g. region-, site- or company-specific) using the framework and the included guidelines as guidance.

III.B. Accounting Treatment of Water Use

III.B.1. Objective

79. The objective of this manual is to describe a methodology for the accounting[9] treatment of water use.

III.B.2. Scope

80. This methodology should be applied by all enterprises in accounting for all types of water used by them as defined in section III.B.3.

81. This guidance is not intended for companies in the public water supply sector. Public water supply refers to water withdrawn by public and private water suppliers. An enterprise is a water supplier when the rationale for the activities of the company is to distribute water to users.

III.B.3. Definitions

82. The following terms are used in this methodology.

III.B.3.a. General

83. Figure 1 provides an overview of the categories and subcategories of water use.

III.B.3.b. Water Received and its Source

84. Water received is any input of freshwater into the reporting entity, be it withdrawals, deliveries or conveyance gains, which is linked with ordinary and extraordinary activities of the reporting entity:

(a) Withdrawal

Withdrawal is the quantity of water

(i) removed from a ground water source or

(ii) diverted from a surface water source

for the reporting entities' use.

According to the scope of this guidance (see III.B.2, paragraph 81) this category covers water that is withdrawn by the reporting entity itself but does not cover withdrawal by public water suppliers.

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9 Traditionally "accounting" has a financial connotation. In recent years the term "accounting" has also been applied to non-financial environmental aspects of management. According to the US EPA Environmental Accounting Project, Environmental Management Accounting (EMA) can be defined as the identification, collection, estimation, analysis, internal reporting, and use of materials and energy flow information, environmental cost information, and other cost information for both conventional and environmental decision-making within an organization (*Source*: www.EMAwebsite.org).

(b) Delivery

Deliveries are the quantity of water delivered to the reporting entity by a public water supplier.

(c) Conveyance gains

Conveyance is the systematic and intentional movement or transfer of water from one point to another. Withdrawals, deliveries, releases and return flows are the endpoints of conveyances. Conveyance gains may occur through infiltration and inflow (conveyance losses may occur through evaporation from an open system or seepage, see III.B.3.d.(ii), paragraph 106(b)).

III.B.3.c. Kinds of Water Use

85. Water use is divided into off-stream use and in-stream use.

(a) Off-stream water use

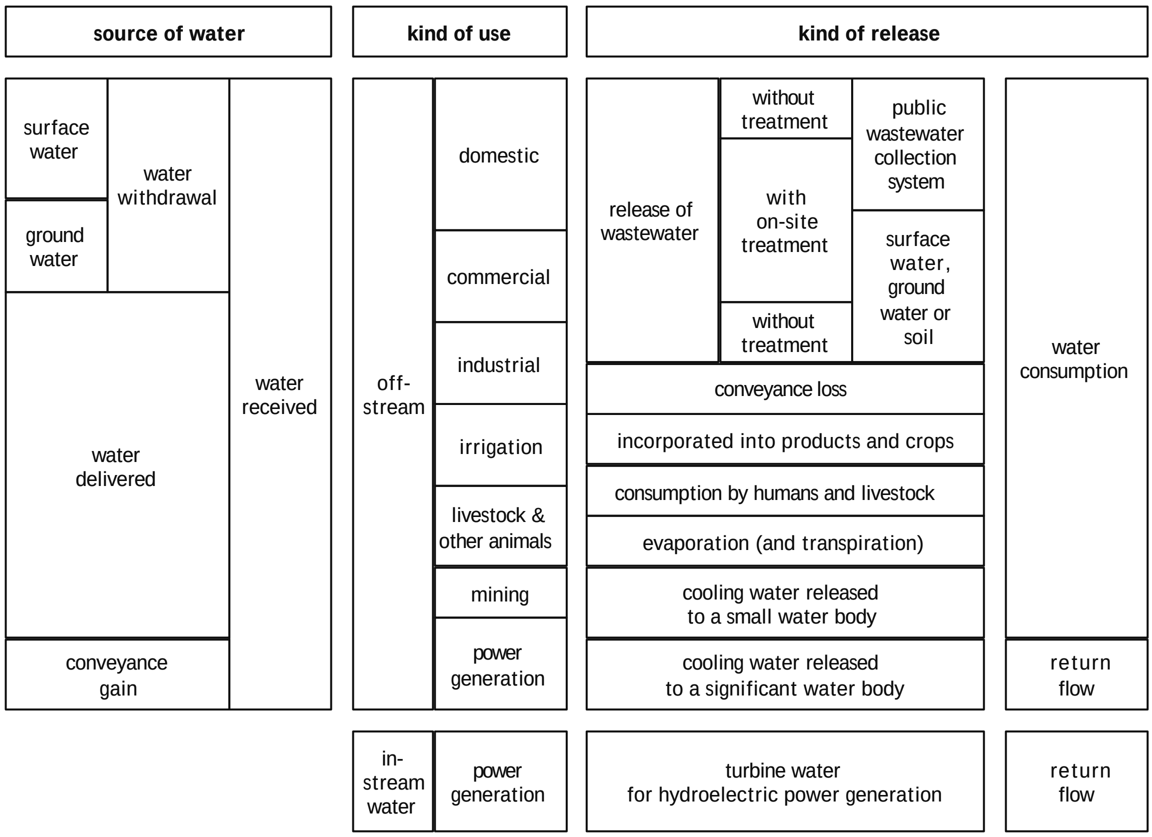
Off-stream use involves the withdrawal or diversion of water from a source, its treatment, distribution and use, and the collection, treatment and release of wastewater and return flow. Off-stream water use covers the following: domestic, commercial and industrial use, water used for irrigation, livestock and other animals, mining and power generation (see III.B.3.c.(i) – III.B.3.c.(vii))

(b) In-stream water use

In-stream use is water that is used, but not withdrawn, from a surface- or ground water source.[10] Commercial in-stream water use activities include, for example, hydroelectric power generation, transportation, fish and shrimp farming. Although in-stream water use is an important aspect of water preservation, current knowledge does not allow for a quantitative inclusion of these flows into an eco-efficiency statement. With the exception of in-stream water use for hydroelectric power generation (turbine water, see III.B.3.c.(vii), paragraph 100), enterprises are advised to disclose qualitative information on in-stream water use for the time being.

[10] In-stream uses can be broadly characterized as streamflows to meet human needs and streamflows to meet ecological needs: (a) human needs include recreation, hydroelectric power generation, transportation, fish and shrimp farming, waste assimilation, aesthetics, and cultural resource preservation; (b) ecological needs include fish and wildlife preservation, biodiversity, wetlands preservation, freshwater dilution of saline estuaries, and maintenance of the riparian zone.

Figure 1
Sub-Categories of Water Use



III.B.3.c.(i) Domestic Water Use

86. Water use is considered to be domestic under the following circumstances:

(a) The use takes place in and on property owned by the reporting entity;
(b) The water is used by employees/members of the organization or their families during non-working hours (e.g. student accommodation on campus, company-owned restaurant or housing);
(c) The water is used for purposes such as drinking, food preparation, bathing, washing dishes and clothes, flushing toilets, car washing, and watering lawns and gardens, etc.[11]

87. In the case of the tourism industry, water use by customers is considered commercial water use (see III.B.3.c.(ii)).

[11] Domestic water-use activities include withdrawals from ground and surface water; deliveries from public water suppliers; consumptive use in the form of evaporation, usually during outdoor use, but also through washing and cooking; releases into surface water, ground water or wastewater-collection systems, usually through septic systems.

III.B.3.c.(ii) Commercial Water Use

88. Commercial water use includes water used by commercial facilities - such as hotels, motels, restaurants, office buildings, retail stores, leisure parks and ski resorts and for transportation - as well as by non-commercial entities such as government and military facilities, hospitals and educational institutions. It includes, for example, water for food preparation, pools and laundries, cooling, snow and ice making, toilet flushing, air-conditioning, washing floors and other surfaces, fountains and watering lawns.[12]

89. Water used for off-stream fish and shrimp farming is considered commercial water use. Off-stream fish hatcheries engaged in hatching fish for release to public lakes and streams for fishing are also classified as commercial use.

III.B.3.c.(iii) Industrial Water Use

90. Industrial water use includes water used to manufacture products such as steel, chemical and paper, as well as water used in refining petroleum and metals. Industrial water use includes, for example, water used as process and production water and boiler feed and for air conditioning, cooling, sanitation, washing, transport of materials, and steam generation for internal use.[13]

91. Industrial water use does not include water used for power generation for sale to third parties, mining of minerals, or the extraction of crude petroleum and gases, which are included in separate categories (see III.B.3.c.(iv), III.B.3.c.(vii)).

III.B.3.c.(iv) Water Use for Mining

92. Mining water use includes water used for the extraction and on-site processing of minerals, including ores, coal, petroleum, and natural gas.[14]

93. Water used in smelting and refining of minerals is considered as industrial use.

[12] Commercial water-use activities include withdrawals from ground or surface water; deliveries from water suppliers; consumptive use in the form of evaporation, usually during outdoor use, but also from wash water and food preparation; release into wastewater-collection systems, ground water or surface water.

[13] Industrial water-use activities include water withdrawal from ground and surface water; deliveries from public water suppliers; consumptive use through evaporation and product incorporation (as in a bottling plant); water and wastewater treatment, recycling, releases to wastewater collection systems, and releases to ground and surface water.

[14] Water use activities in mining include: withdrawals from ground and surface water; deliveries from water suppliers; consumptive use as evaporation and product incorporation during dust control, tailings disposal, slurry conveyance, and drying; wastewater treatment; deliveries of reclaimed wastewater; releases to ground water and surface water; and dewatering.

III.B.3.c.(v) Water Use for Irrigation

94. Water use for irrigation includes water used in agricultural activities for irrigation purposes.[15]

95. Watering of lawns and gardens is considered domestic or commercial water use.

III.B.3.c.(vi) Water Use for Livestock and other Animals

96. Water use for livestock and other animals includes water used to raise cattle, sheep, goats, hogs, poultry, llamas, horses in captivity and others. It excludes water used for fish and shrimp farming, which is considered commercial off-stream water use (see paragraph 89).[16]

97. Under this category, water used by the animals for drinking, dairy sanitation, cleaning and waste-disposal systems, cooling of an animal or a product and processing animal products are included. It also includes evaporation from stock ponds and incidental water losses.

III.B.3.c.(vii) Water Use for Thermoelectric and Hydroelectric Power Generation

98. The thermoelectric power generation category includes water used in the generation of electric power when the following fuel types are used: fossil, nuclear, biomass, waste, or geothermal energy.

99. The hydroelectric power generation category includes water used in the generation of electric power by utilising either cascading water or water pressure.

100. The water used for hydroelectric power generation which drives the turbine generators and is returned to the stream or is recycled is considered return flow and not consumptive use.

101. Cooling water used for thermoelectric power generation in the condenser to cool the steam back into water is discharged as return flow or is recycled through cooling ponds or towers. In general the release of cooling water is considered consumptive use (see III.B.3.d.(ii), paragraph 105). It is not considered consumptive use if the release is discharged into a significant water body such as an ocean, a major river or a lake at a temperature not significantly higher than the water body (see III.B.3.d).

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15 Water-use activities in irrigation include: water withdrawal from ground and surface water; deliveries from public water suppliers; consumptive use through evaporation and product incorporation (in plants and releases to ground and surface water).

16 Water-use activities in the livestock and animal specialties categories include withdrawals from ground or surface water; deliveries from water suppliers; consumptive use in the form of evaporation and incorporation into the animal and animal products, such as milk; and releases of wastewater.

102. Make up water to replace the water lost as steam, blowdown (purging) of boilers, washing of stacks, plant and employee sanitation, water and wastewater treatment, and in nuclear plants, to keep the nuclear fuel from overheating and melting is considered consumptive use.

III.B.3.d. Releases of Water

III.B.3.d.(i) Return flow

103. Return flow is the quantity of water that is discharged after use to surface water, ground water or soil so that it becomes available for immediate[17] reuse.

104. Return flow is either

(a) Off-stream cooling water released to a significant surface/ground water body or

(b) In-stream use of water to drive a turbine to produce hydroelectricity.

III.B.3.d.(ii) Water Consumption

105. Water consumed is that amount of water received that is not available for immediate reuse/consumption. It includes water that evaporates, transpires, is incorporated into products or crops, is consumed by humans or livestock, or otherwise removed from the immediate water environment. It also includes waste water that is released to the public waste water collection system, to surface or ground water bodies or to the soil[18] and that is not available for immediate consumption (e.g. water is degraded in quality).

106. Water consumption is the difference between water received and off-stream return flow (see Figure 1). It includes:

(a) Release of waste water

This is the quantity of water released after use or treatment by the reporting entity. This category includes:

(i) Release of wastewater into public wastewater collection systems after use by the reporting entity;

(ii) Release of wastewater into public wastewater collection systems after use and on-site treatment by the reporting entity;

(iii) Release of wastewater to surface water, ground water or soil after use by the reporting entity;

[17] The criterion used here is "immediate" to differentiate between consumption and return flow. As all water released becomes available for reuse sooner or later immediate is the only criterion, which draws a questionable line between consumption and return flow.

[18] Water that is returned to the soil to percolate downwards to a deep water table with the intention of making it available again is considered consumptive use, although it is available for future (but not for immediate) consumption.

(iv) Release of wastewater to surface water, ground water or soil after use and on-site treatment by the reporting entity.

(b) Conveyance losses (see III.B.3.b, paragraph 84(c));

(c) Water incorporated into products and crops;

(d) Water consumed by humans and livestock (drinking);

(e) Water evaporated and transpired;

(f) Cooling water that is not released to a significant water body (see III.B.3.c.(vii), paragraph 101).

107. The item "water consumption" is used for the calculation of the eco-efficiency indicator "water consumption per net value added" (see paragraph 76(a)).

III.B.4. Recognition

108. Water use as defined by III.B.3 should be recognized in the period in which the flow occurs.

109. If water is temporarily stored on-site the stock should be recognized at the beginning and at the end of the reporting period. This excludes water in closed systems, which are not used as reserves (e.g. water in tubes, small boilers used to catch an overshoot of water, etc.).

III.B.5. Measurement of Water Use

110. Water use should be metered.

111. Water use should be measured in litres or cubic metres.

112. If an amount of water used is estimated or calculated the range of uncertainty should be recorded.

113. Water use should be reported according to volume (litres, cubic metres).

III.B.6. Disclosure

114. An enterprise should disclose:

(a) The eco-efficiency indicator "water consumption per net value added";

(b) The accounting policies adopted on water use;

(c) The total amount of water received, the amount per source and use category as recognized during the accounting period and the respective amounts of the previous year;

(d) Total water consumption, the total return flow and the respective amount per category as defined and recognized during the accounting period and the respective amounts of the previous year;

(e) Qualitative information on the wastewater treatment technology applied on-site and in the public wastewater system;

(f) The management's stance on the water use policy, the objectives and targets regarding water use and the measures taken to achieve the targets.

An example of a disclosure of water use is given in the annex, III.B.7.a.

III.B.7. Annexes to Water Use

III.B.7.a. Example of Disclosure of Water Use

115. The following tables show an example of a disclosure on water use. Enterprises are advised to only include the line items that actually show a flow.

116. A disclosure on water use consists of three parts:

(a) Total water consumption and return flow (Table 1);
(b) Water received and its use (Table 2);
(c) Accounting policy on water use, water policy, targets and measures (Table 3).

Table 1
Water Consumption and Return Flow

Water consumption (m^3)	**2000**	**2001**
Release of wastewater to public wastewater collection systems		
- with on-site treatment*	1 000	1 100
- without treatment	1 000	1 000
Release of wastewater to surface water, ground water or soil		
- with on-site treatment^	1 000	1 000
- without treatment	1 000	1 100
Conveyance losses	100	200
Consumption by humans and livestock	20	50
Evaporation	500	600
Cooling water	280	300
Change in water storage	0	0
Total water consumption°	**4 900**	**5 350**
Net value added (€)	10 000	11 000
Eco-efficiency indicator "water consumption/net value added" (m^3/€)	**0.490**	**0.486**
Return flow (m^3)		
Cooling water	100	150
Total return flow°	**100**	**150**

*Notes: *Average treatment technology applied.*
^Best available technology applied.
°Total Water Consumption + Return Flow = Water Received

Table 2
Water Received and its Use

Water Received [m^3]	**2000**	**2001**
Water withdrawal from a ground water source	4'000	4'100
Water diverted from a surface water source	500	600
Water delivered	500	800
Conveyance gains	-	-
Total water received	**5'000**	**5'500**
Use		
Domestic	100	150
Commercial	900	950
Industrial	4'000	4'400

Table 3
Accounting Policy, Water Policy, Targets and Measures

Accounting policy
Water policy
Targets
Measures

III.C. Accounting Treatment of Energy Use

III.C.1. Objective

117. The objective of this manual is to describe a method for the accounting treatment of energy use.

III.C.2. Scope

118. This guidance should be applied by all enterprises in accounting for all types of energy used by them as defined in III.C.3.

119. This guidance is not intended for energy-producing[19] enterprises. An enterprise is an energy producer when the rationale for the activities of the company is to sell energy in whatever form. For the energy-producing industry this guidance on energy should be used with care. In the future specific guidance on energy use by energy-producing companies needs to be developed by the industry itself.

120. This manual treats energy flows from a thermodynamic perspective. The focus of this guidance is therefore on entropy and energy conservation. The impacts of energy use or issues concerning the supply of energy, the technology and the source used, the quality in terms of renewable/non-renewable energy and energy-linked emissions of greenhouse gases are not covered by this manual but by the accounting guidance on energy supply and greenhouse gases.

III.C.3. Definitions

121. The terms used for the accounting treatment of energy use are defined as follows:

III.C.3.a. General Definition of Energy and Energy Use

122. Energy is the capacity for doing work and/or the capacity for providing heat.

123. Energy use is defined as all inputs into the reporting entity whose purpose it is to use its productive capacity for doing work and/or for providing heat for the reporting entities' activities, products and/or services.

III.C.3.b. Purchase and Sale of Energy

124. Any form of energy from any source as defined by III.C.3.c that a company receives from third parties and is used for the company's activities, products and/or services shall be considered a purchase of energy regardless of

19 Energy is not produced but rather transformed from one form to another. Nevertheless, in everyday language the term "produced" is used.

whether the underlying financial transaction has a negative or positive value for the reporting entity.

125. Any form of energy from any source as defined by III.C.3.c that a company transfers to third parties and is being used for the third parties' activities, products and/or services shall be considered a sale of energy regardless of whether the underlying financial transaction has a negative or positive value for the reporting entity.

III.C.3.c. Forms and Sources of Energy

126. Different forms and sources of energy are defined in the appendix III.C.7.b.

127. The different forms and sources of energy relevant for companies covered by this manual (non-energy sector only) are:

(a) Heat from

(i) The combustion of petroleum

Including: liquefied petroleum gases and methane, motor gasoline, aviation gasoline, jet fuels, kerosene, gas/diesel fuel, heavy fuel oil, naphtha, petroleum coke.[20]

(ii) The combustion of gas

Including: natural gas, gas works gas and substitute gas, coke oven gas, blast furnace gas.

(iii) The combustion of coal and coal products

Including: coking coal (hard coal), bituminous coal and anthracite (hard coal), sub-bituminous coal, lignite and brown coal, peat, coke oven coke, gas coke, patent fuel and brown coal/peat briquettes (BKB).

(iv) The combustion of biomass

Including: direct combustion of biomass, biofuels and biochemicals.

(v) The combustion (incineration) of waste

(vi) Steam

Including: district heating systems and other steam generated outside the reporting entity

(vii) The surrounding natural systems

Including: geothermal heat (deep heat mining, including shallow ground and ambient air heat pumps), ocean thermal heat, direct solar heat (concentrating solar systems, passive solar heating, solar hot water systems, solar process heat, solar space heating and cooling).

[20] Non-energy refined petroleum products used such as white spirit, industrial spirit, lubricating oils and grease, bitumen (asphalt), paraffin waxes, mineral oils and other non-energy petroleum products are not considered energy use.

(b) Work[21]
   (i) Electricity (i.e. from hydropower, nuclear power station, batteries)
   (ii) Pressure-volume work (e.g. steam, compressed air)
   (iii) Mechanical work (e.g. rotation produced by a combustion engine, a water wheel in a mill, a wind rotor)

128. Petrochemical feedstock use is not considered energy use.

129. Heat from the surrounding natural system, including geothermal heat, ocean thermal heat and direct solar heat, is not accounted for.

130. The use of excess heat from third parties is not accounted for. When the purpose of the process from which the heat originates is not heat generation, it is regarded as excess heat.

131. For the purpose of this guideline, transport services supplied by third parties other than subcontractors (see next paragraph) are not accounted for.[22]

132. Transport-related energy use includes all transports carried out as part of the company's business activities (transportation of goods and personnel) either by the company itself or by a subcontractor[23] in charge of a company's transports.

(a) Vehicle transport by road shall be accounted for using the actual fuel consumption of the vehicles used. If no fuel data are available, estimation values based on the technology and/or model year of the vehicle should be used. Assumptions made should be disclosed. Table 4 provides guidance.

(b) Non-road transportation, including air freight, train freight, inland shipping, marine shipping, passenger flights and passenger train rides shall be accounted for using actual fuel or electricity consumption of the mode of transport used. If no fuel data are available, estimation values based on the technology of the vehicle should be used. Assumptions made should be disclosed.

21 Work involves the net directed movement of matter from one location to another.

22 These services can nevertheless be disclosed separately (see III.C.6).

23 A subcontractor works in the name and on behalf of the company, for example rented personnel transports, company owned or rented business jets.

Table 4
Road Transportation: Guidance Values for Fuel Consumption

Transport	US		Europe	
	Model Year	l / 100 km	Model Year	l / 100 km
Gasoline passenger car				
Low-emission vehicle technology	>1996	11.8		
Three-way catalyst control	1996	12.0	1989-95	8.5
Early three-way catalyst control	1983	12.5		
Oxidation catalyst	1978	16.1	1988-91	8.1
Non-catalyst control	1973	22.2	1980-90	8.3
Early non-catalyst controls			1971-79	9.4
Uncontrolled	1964	21.3	pre-1970	11.2
Light duty gasoline trucks				
Moderate control			–	13.6
Low-emission vehicle technology	>1996	16.7		
Three-way catalyst control	1996	16.7		
Early three-way catalyst control	1983	20.8		
Oxidation catalyst	1978	20.8		
Non-catalyst control	1973	25.0		
Uncontrolled	1964	24.4		
Heavy duty gasoline vehicle				
Three-way catalyst control	1996	43.5		
Non-catalyst control	1983	43.5		
Uncontrolled	1968	55.6	–	22.5
Diesel passenger car and light trucks				
Advanced control	1996	10.0		
Moderate control	1983	10.4	–	7.3
Uncontrolled	1978	13.3		
Light duty diesel truck				
Advanced control	1996	13.9		
Moderate control	1983	13.9	–	10.9
Uncontrolled	1978	17.5		
Heavy duty diesel vehicle				
Advanced control	1996	41.7		
Moderate control	1983	41.7		29.9
Uncontrolled	1968	45.5		
Motorcycles (4 stroke)				
Non-catalyst controls	1996	9.3		
Uncontrolled	1973	11.2	–	5.1

Source: IPCC (1996(b)).

III.C.3.c.(i) Conversion Factors from Energy Source to Thermal Equivalents for Fossil Fuel and Biomass Fuels

133. Different energy commodities such as petroleum products, gas, coal, coal products and biomass fuels all have a different caloric content. To make them comparable they are converted into thermal equivalents using their respective net caloric content[24] (see III.C.3.c.i.A for petroleum products, III.C.3.c.i.B for coal and coal products, III.C.3.c.i.C for gas and III.C.3.c.i.D for biomass fuels).

III.C.3.c.i.A. Petroleum Products

134. Petroleum products include ethane, LPG, naphtha, aviation gasoline, motor gasoline, jet gasoline, jet kerosene, other kerosene, gas/diesel fuel, heavy fuel oil and petroleum coke.

135. Petroleum products are converted into heat equivalents using the net caloric content of the energy commodity.

136. If the energy commodity is used in a country for which specific values are listed then these values should be used. Otherwise the default value should be applied (Table 5).

[24] The difference between net caloric value (NCV) and gross caloric value is the latent heat of vaporization of the water produced during combustion of the fuel. In the case of coal and oil, NCV is 5 per cent less than gross values, while for most gases the difference is between 9 and 10 per cent. (OECD/IEA 2001a).

Table 5
Net Caloric Values for Petroleum Products

Net caloric values	**Default and country specific values [GJ per tonne]**						
Product	Default value	**Algeria**	**Argentina**	**Brazil**	**China, PR**	**Colombia**	**Jordan**
Ethane	47.31						
LPG	47.31	49.40	46.05	49.19	50.24		46.56
Motor gasoline	44.80		43.54	46.98	43.12	43.57	43.54
Aviation gasoline	44.80		43.54	47.27	43.12		43.54
Jet gasoline	44.80		43.54		43.12		
Jet kerosene	44.59		43.12	46.43	43.12	44.16	43.58
other kerosene	43.75		43.12	46.43	43.12	43.10	43.29
Gas/diesel fuel	43.33		42.71	45.01	42.71	43.10	42.66
Heavy fuel oil	40.19		41.03	45.64	41.87	41.27	40.49
Naphtha	45.01		43.33	47.39			
Petroleum coke	30.98		30.14	35.59			
Product	**Lebanon**	**Malaysia**	**Namibia**	**Nepal**	**Nicaragua**	**Pakistan**	**Paraguay**
Ethane							
LPG		45.57		49.19	47.02	45.43	45.85
Motor gasoline		43.99	46.89	47.19			
Aviation gasoline		43.96	51.50		44.13	43.75	
Jet gasoline							
Jet kerosene	44.67	43.21	44.21	46.60	42.91	43.29	40.53
other kerosene		43.21		46.60	42.91	43.29	
Gas/diesel fuel		42.50	45.43	46.01	42.75	44.09	42.87
Heavy fuel oil		41.53	41.74	44.38	41.32	40.86	41.03
Naphtha		44.13				44.84	39.94
Petroleum coke		36.38					
Product	**South Africa**	**Sri Lanka**	**Thailand**	**Tunisia**	**Venezuela**	**Viet Nam**	
Ethane			46.89				
LPG	46.77	44.38	50.24	46.31	49.27	45.55	
Motor gasoline	44.05	45.64	43.12	43.88	46.94	43.96	
Aviation gasoline	45.55	45.64		43.88	47.11		
Jet gasoline	40.74	45.64		43.88	47.16		
Jet kerosene	41.07	43.96		43.33	46.09	43.21	
other kerosene	43.25	43.96		43.21	45.93	43.21	
Gas/diesel fuel	42.91	43.96	42.37	43.00	45.25	42.50	
Heavy fuel oil	41.83	41.03	42.33	40.99	43.29	41.45	
Naphtha	44.92	45.64		44.13	47.09		
Petroleum coke					28.89		

Source: OECD/IEA (2001a, 2001b, 2001c), see Table 6 for a conversion from volume to mass.

Table 6
Densities of Petroleum Products

Density	(litre per tonne)		
Product	**Default**	**OECD Europe**	**OECD**
Ethane	2 678		
LPG	1 843		
Naphtha	1 351	1 414	
Aviation gasoline	1 414		
Motor gasoline	1 356	1 343	
Jet gasoline	1 260		1 311
Jet kerosene	1 260	1 252	
other kerosene	1 230	1 252	
Gas/diesel fuel	1 185		
Heavy fuel oil	1 058	1 025	
Petroleum coke	874		

Source: OECD/IEA (2001a, 2001b, 2001c).

III.C.3.c.i.B. Coal and Coal Products

137. Coal and coal products include coking coal (hard coal), bituminous coal and anthracite (hard coal), sub-bituminous coal, lignite and brown coal, peat, coke oven coke, gas coke, patent fuel and brown coal/peat briquettes (BKB).

138. Coal and coal products are converted into heat equivalents using the net caloric content of the energy commodity (see Table 7 and Table 8 for OECD countries, and Table 9 to Table 17 for non-OECD countries).

139. If the actual net caloric value is known, these values should be used. Otherwise country-specific or region-specific values should be applied.

Table 7
Net Caloric Values for Coal and Coal Products
OECD Countries A-J

Net caloric values [GJ per tonne]	Australia	Austria	Belgium	Canada	Czech Republic
Coking coal	28.27	28.00	29.31	27.55	29.11
Other bituminous coal/anthracite	25.40	28.00	28.03	28.17	24.14
Sub-bituminous coal	18.48	20.68	22.05	17.38	12.86
Lignite/brown coal	9.12	11.00	21.56	14.25	8.68
Peat	8.37	8.37	8.37	8.37	8.37
Patent fuel	29.31	17.40	29.31	28.05	29.31
Coke oven coke and lignite coke	25.65	28.50	29.31	27.39	28.56
Gas coke	25.65	28.64	28.05	27.39	29.31
Bkb/peat briquettes	21.00	19.30	20.10	20.10	24.62
Net caloric values [GJ per tonne]	**Denmark**	**Finland**	**France**	**Germany**	**Greece**
Coking coal	25.12	29.30	30.35	29.00	29.31
Other bituminous coal/anthracite	25.08	25.50	26.43	25.50	27.21
Sub-bituminous coal	18.00	8.37	23.03	8.37	15.00
Lignite/brown coal	18.00	8.37	17.00	8.78	5.59
Peat	8.37	10.20	8.37	8.37	8.37
Patent fuel	29.31	29.31	32.00	31.40	29.30
Coke oven coke and lignite coke	29.30	29.30	28.00	28.65	29.30
Gas coke	28.89	28.05	28.05	28.65	29.31
Bkb/peat briquettes	18.30	20.10	20.10	20.23	15.28
Net caloric values [GJ per tonne]	**Hungary**	**Iceland**	**Ireland**	**Italy**	**Japan**
Coking coal	31.61	28.05	29.10	30.98	30.23
Other bituminous coal/anthracite	14.58	28.05	27.29	26.65	24.28
Sub-bituminous coal	14.83	16.75	16.75	18.00	16.29
Lignite/brown coal	8.57	16.75	19.68	10.61	16.29
Peat	8.37	8.37	8.55	8.37	8.37
Patent fuel	16.06	29.31	30.91	29.31	27.05
Coke oven coke and lignite coke	29.67	26.67	32.66	29.31	28.64
Gas coke	30.11	28.05	28.05	26.80	28.64
Bkb/peat briquettes	19.72	20.10	18.55	18.00	21.48

Source: OECD/IEA (2001b).

Table 8
Net Caloric Values for Coal and Coal Products
OECD Countries K-U

Net caloric values [GJ per tonne]	Rep. of Korea	Luxembourg	Mexico	Netherlands	New Zealand
Coking coal	27.55	29.31	23.48	28.67	30.45
Other bituminous coal/anthracite	24.45	29.30	23.48	24.93	28.62
Sub-bituminous coal	19.84	20.93	18.84	20.10	21.54
Lignite/brown coal	8.37	20.03	23.48	2	14.06
Peat	8.37	8.37	8.37	8.37	8.37
Patent fuel	29.31	31.40	29.31	29.30	27.17
Coke oven coke and lignite coke	28.03	28.50	26.52	28.50	27.17
Gas coke	29.31	28.51	26.52	28.50	35.06
Bkb/peat briquettes	20.10	20.10	20.10	2	20.10
Net caloric values [GJ per tonne]	**Norway**	**Poland**	**Portugal**	**Slovak Republic**	**Spain**
Coking coal	28.10	29.16	29.30	28.93	3
Other bituminous coal/anthracite	28.10	22.33	25.82	25.22	21.94
Sub-bituminous coal	8.37	8.49	17.16	12.20	13.33
Lignite/brown coal	8.37	8.57	8.37	12.10	7.38
Peat	8.37	8.37	8.37	8.37	8.37
Patent fuel	29.31	24.12	29.31	29.31	29.30
Coke oven coke and lignite coke	28.50	28.50	28.04	28.02	30.28
Gas coke	28.05	29.31	28.05	28.05	28.05
Bkb/peat briquettes	20.10	18.25	20.10	21.43	20.22
Net caloric values [GJ per tonne]	**Sweden**	**Switzerland**	**Turkey**	**United Kingdom**	**United States**
Coking coal	3	28.68	31.00	29.73	29.68
Other bituminous coal/anthracite	26.75	28.05	23.76	25.18	27.04
Sub-bituminous coal	8.37	20.10	18.00	8.37	20.04
Lignite/brown coal	8.37	20.10	10.04	8.37	14.10
Peat	12.10	8.37	8.37	8.37	8.37
Patent fuel	29.31	28.05	29.31	29.35	29.31
Coke oven coke and lignite coke	28.05	28.05	29.30	28.31	27.47
Gas coke	28.05	28.05	29.31	26.96	28.05
Bkb/peat briquettes	20.10	20.10	20.93	20.10	20.10

Source: OECD/IEA (2001b).

Table 9
Net Caloric Values for Coal and Coal Products
Non-OECD Countries A-B

Net caloric values [GJ per tonne]	Albania	Algeria	Angola	Argentina	Armenia
Hard coal	27.21	25.75	25.75	24.70	18.58
Lignite/brown coal/sub-bituminous ~	9.84	8.37		8.37	14.65
Coking coal	27.21	25.75	25.75	24.70	18.58
Other bituminous coal/anthracite	27.21	25.75	25.75	24.70	18.58
Sub-bituminous coal	9.84	8.37		8.37	14.65
Lignite/brown coal	9.84	8.37		8.37	14.65
Peat	8.37	8.37	8.37	8.37	8.37
Patent fuel		29.31			29.31
Coke oven coke and lignite coke	27.21	27.21		28.46	25.12
Gas coke					
BKB/Peat Briquettes		20.10		20.10	20.10
Net caloric values [GJ per tonne]	**Azerbaijan**	**Bahrain**	**Bangladesh**	**Belarus**	**Benin**
Hard coal	18.58	25.75	20.93	25.54	
Lignite/brown coal/sub-bituminous ~	14.65	8.37	8.37	14.65	
Coking coal	18.58	25.75	20.93	25.54	
Other bituminous coal/anthracite	18.58	25.75	20.93	25.54	
Sub-bituminous coal	14.65	8.37	8.37	14.65	
Lignite/brown coal	14.65	8.37	8.37	14.65	
Peat	8.37	8.37	8.37	8.37	8.37
Patent fuel	29.31			29.31	
Coke oven coke and lignite coke	25.12	27.21	27.21	25.12	
Gas coke					
BKB/Peat Briquettes	20.10	20.10	20.10	8.37	
Net caloric values [GJ per tonne]	**Bolivia**	**Bosnia and Herzegovina**	**Brazil**	**Brunei**	**Bulgaria**
Hard coal	25.75	25.95	26.80	25.75	27.21
Lignite/brown coal/sub-bituminous ~	8.37	13.05	8.37	8.37	6.91
Coking coal	25.75	25.95	31.40	25.75	32.66
Other bituminous coal/anthracite	25.75	25.95	15.83	25.75	25.12
Sub-bituminous coal	8.37	13.05	8.37	8.37	11.30
Lignite/brown coal	8.37	13.05	8.37	8.37	6.91
Peat	8.37	8.37	8.37	8.37	8.37
Patent fuel		29.31			29.31
Coke oven coke and lignite coke	27.21	26.90	27.76	27.21	30.14
Gas coke					
Bkb/peat briquettes	20.10	20.10	20.10	20.10	18.34

Source: OECD/IEA (2001c).

Table 10
Net Caloric Values for Coal and Coal Products
Non-OECD Countries/Territories B-C

Net caloric values [GJ per tonne]	Brazil	Brunei	Bulgaria	Cameroon	Chile
Hard coal	26.80	25.75	27.21	25.75	28.43
Lignite/brown coal/sub-bituminous ~	8.37	8.37	6.91		17.17
Coking coal	31.40	25.75	32.66	25.75	28.43
Other bituminous coal/anthracite	15.83	25.75	25.12	25.75	28.43
Sub-bituminous coal	8.37	8.37	11.30		17.17
Lignite/brown coal	8.37	8.37	6.91		17.17
Peat	8.37	8.37	8.37	8.37	8.37
Patent fuel			29.31		
Coke oven coke and lignite coke	27.76	27.21	30.14		28.43
Gas coke					
Bkb/peat briquettes	20.10	20.10	18.34		20.10

Net caloric values [GJ per tonne]	China	Taiwan POC	Colombia	Congo	Congo, DR
Hard coal	21.35	26.80	27.21		25.23
Lignite/brown coal/sub-bituminous ~	8.37	8.37	8.37		8.37
Coking coal	26.80	26.80	27.21		25.23
Other bituminous coal/anthracite	20.93	26.80	27.21		25.23
Sub-bituminous coal	8.37	8.37	8.37		8.37
Lignite/brown coal	8.37	8.37	8.37		8.37
Peat	8.37	8.37	8.37	8.37	8.37
Patent fuel	17.75				29.31
Coke oven coke and lignite coke	26.80	27.21	20.10		27.21
Gas coke	28.47				
Bkb/peat briquettes	18.05	20.10	20.10		20.10

Net caloric values [GJ per tonne]	Costa Rica	Côte d'Ivoire	Croatia	Cuba	Cyprus
Hard coal	25.75	25.75	28.00	25.75	25.75
Lignite/brown coal/sub-bituminous ~	8.37	8.37	14.60	8.37	
Coking coal	25.75	25.75	29.31	25.75	25.75
Other bituminous coal/anthracite	25.75	25.75	26.97	25.75	25.75
Sub-bituminous coal	8.37	8.37	14.60	8.37	
Lignite/brown coal	8.37	8.37	14.60	8.37	
Peat	8.37	8.37	8.37	8.37	8.37
Patent fuel	29.31				
Coke oven coke and lignite coke	27.21	27.21	29.31	27.21	27.21
Gas coke					
Bkb/peat briquettes	20.10	20.10	20.10	20.10	

Source: OECD/IEA (2001c).

Table 11
Net Caloric Values for Coal and Coal Products
Non-OECD Countries/Territories D-H

Net caloric values [GJ per tonne]	Dominican Republic	Ecuador	Egypt	El Salvador	Eritrea
Hard coal	25.75	25.75	25.75	25.75	
Lignite/brown coal/sub-bituminous ~	8.37	8.37	8.37	8.37	
Coking coal	25.75	25.75	25.75	25.75	
Other bituminous coal/anthracite	25.75	25.75	25.75	25.75	
Sub-bituminous coal	8.37	8.37	8.37	8.37	
Lignite/brown coal	8.37	8.37	8.37	8.37	
Peat	8.37	8.37	8.37	8.37	8.37
Patent fuel	29.31			29.31	
Coke oven coke and lignite coke	27.21	27.21	27.21	27.21	
Gas coke			28.05		
Bkb/peat briquettes	20.10	20.10	20.10	20.10	

Net caloric values [GJ per tonne]	Estonia	Ethiopia	Gabon	Georgia	Ghana
Hard coal	24.45		25.75	18.58	25.75
Lignite/brown coal/sub-bituminous ~	8.79		8.37	14.65	
Coking coal	24.45		25.75	18.58	25.75
Other bituminous coal/anthracite	24.45		25.75	18.58	25.75
Sub-bituminous coal	8.37		8.37	14.65	
Lignite/brown coal	8.37		8.37	14.65	
Peat	8.37	8.37	8.37	8.37	8.37
Patent fuel	29.31			29.31	
Coke oven coke and lignite coke	29.31		27.21	25.12	27.21
Gas coke					
Bkb/peat briquettes	16.75		20.10	20.10	

Net caloric values [GJ per tonne]	Gibraltar	Guatemala	Haiti	Honduras	Hong Kong, China
Hard coal	25.75		25.75	25.75	25.75
Lignite/brown coal/sub-bituminous ~	8.37		8.37	8.37	8.37
Coking coal	25.75		25.75	25.75	25.75
Other bituminous coal/anthracite	25.75		25.75	25.75	25.75
Sub-bituminous coal	8.37		8.37	8.37	8.37
Lignite/brown coal	8.37		8.37	8.37	8.37
Peat	8.37	8.37	8.37	8.37	8.37
Patent fuel			29.31	29.31	
Coke oven coke and lignite coke	27.21		27.21	27.21	27.21
Gas coke					
Bkb/peat briquettes	20.10		20.10	20.10	20.10

Source: OECD/IEA (2001c).

Table 12
Net Caloric Values for Coal and Coal Products
Non-OECD Countries I-Lib

Net caloric values [GJ per tonne]	India	Indonesia	Iran, Islamic Rep.	Iraq	Israel
Hard coal	19.98	25.75	25.75	25.75	26.22
Lignite/brown coal/sub-bituminous ~	9.80	8.37	8.37	8.37	4.19
Coking coal	19.98	25.75	25.75	25.75	26.22
Other bituminous coal/anthracite	19.98	25.75	25.75	25.75	26.22
Sub-bituminous coal	9.80	8.37	8.37	8.37	8.37
Lignite/brown coal	14.86	8.37	8.37	8.37	4.19
Peat	8.37	8.37	8.37	8.37	8.37
Patent fuel					
Coke oven coke and lignite coke	27.21	27.21	27.21	27.21	27.21
Gas coke					
Bkb/peat briquettes	20.10	20.10	20.10	20.10	20.10
Net Caloric Values [GJ per tonne]	**Jamaica**	**Jordan**	**Kazakhstan**	**Kenya**	**Korea, DPR**
Hard coal	25.75	25.75	18.58	25.75	25.75
Lignite/brown coal/sub-bituminous ~	8.37	8.37	14.65	8.37	17.58
Coking coal	25.75	25.75	18.58	25.75	25.75
Other bituminous coal/anthracite	25.75	25.75	18.58	25.75	25.75
Sub-bituminous coal	8.37	8.37	14.65	8.37	17.58
Lignite/brown coal	8.37	8.37	14.65	8.37	17.58
Peat	8.37	8.37	8.37	8.37	8.37
Patent fuel			29.31		
Coke oven coke and lignite coke	27.21	27.21	25.12	27.21	27.21
Gas coke			28.47		
Bkb/peat briquettes	20.10	20.10	20.10	20.10	20.10
Net Caloric Values [GJ per tonne]	**Kuwait**	**Kyrgyzstan**	**Latvia**	**Lebanon**	**Libyan AJ**
Hard coal	25.75	18.58	25.95	27.67	25.75
Lignite/brown coal/sub-bituminous ~	8.37	14.65	14.65	8.37	8.37
Coking coal	25.75	18.58	25.95	25.75	25.75
Other bituminous coal/anthracite	25.75	18.58	25.95	27.67	25.75
Sub-bituminous coal	8.37	14.65	14.65	8.37	8.37
Lignite/brown coal	8.37	14.65	14.65	8.37	8.37
Peat	8.37	8.37	8.37	8.37	8.37
Patent fuel		29.31	29.31		
Coke oven coke and lignite coke	27.21	25.12	25.12	27.21	27.21
Gas coke					
Bkb/peat briquettes	20.10	20.10	8.37	20.10	20.10

Source: OECD/IEA (2001c).

Table 13
Net Caloric Values for Coal and Coal Products
Non-OECD Countries/Territories Lit-P

Net caloric values [GJ per tonne]	Lithuania	Macedonia, FYR	Malaysia	Malta	Moldova, Republic of
Hard coal	25.12	25.95	29.31	25.75	18.58
Lignite/brown coal/sub-bituminous ~	14.65	13.05	11.30	8.37	14.65
Coking coal	25.12	25.95	29.31	25.75	18.58
Other bituminous coal/anthracite	25.12	25.95	29.31	25.75	18.58
Sub-bituminous coal	14.65	13.05	11.30	8.37	14.65
Lignite/brown coal	14.65	13.05	11.26	8.37	14.65
Peat	11.68	8.37	8.37	8.37	8.37
Patent fuel	29.31	29.31			29.31
Coke oven coke and lignite coke	29.30	26.90	26.38	27.21	25.12
Gas coke					
Bkb/peat briquettes	14.65	20.10	20.10	20.10	20.10
Net caloric values [GJ per tonne]	**Morocco**	**Mozambique**	**Myanmar**	**Namibia**	**Nepal**
Hard coal	24.70	25.00	25.75	22.69	25.12
Lignite/brown coal/sub-bituminous ~	8.37	8.37	8.37	8.37	8.37
Coking coal	24.70	25.75	25.75	25.75	25.12
Other bituminous coal/anthracite	24.70	25.00	25.75	22.69	25.12
Sub-bituminous coal	8.37	8.37	8.37	8.37	8.37
Lignite/brown coal	8.37	8.37	8.37	8.37	8.37
Peat	8.37	8.37	8.37	8.37	8.37
Patent fuel	27.21			29.31	
Coke oven coke and lignite coke	27.21	27.21	27.21	27.21	27.21
Gas coke					
Bkb/peat briquettes	20.10	20.10		20.10	20.10
Net caloric values [GJ per tonne]	**Netherlands Antilles**	**Nicaragua**	**Nigeria**	**Oman**	**Pakistan**
Hard coal	25.75	25.75	25.75	25.75	18.73
Lignite/brown coal/sub-bituminous ~	8.37	8.37	8.37	8.37	8.37
Coking coal	25.75	25.75	25.75	25.75	18.73
Other bituminous coal/anthracite	25.75	25.75	25.75	25.75	18.73
Sub-bituminous coal	8.37	8.37	8.37	8.37	8.37
Lignite/brown coal	8.37	8.37	8.37	8.37	8.37
Peat	8.37	8.37	8.37	8.37	8.37
Patent fuel		29.31			
Coke oven coke and lignite coke	27.21	27.21	27.21	27.21	27.21
Gas coke					
Bkb/peat briquettes	20.10	20.10	20.10	20.10	20.10

Source: OECD/IEA (2001c).

Table 14
Net Caloric Values for Coal and Coal Products
Non-OECD Countries N-So

Net caloric values [GJ per tonne]	Nigeria	Oman	Pakistan	Panama	Paraguay
Hard coal	25.75	25.75	18.73	25.75	25.75
Lignite/brown coal/sub-bituminous ~	8.37	8.37	8.37	8.37	8.37
Coking coal	25.75	25.75	18.73	25.75	25.75
Other bituminous coal/anthracite	25.75	25.75	18.73	25.75	25.75
Sub-bituminous coal	8.37	8.37	8.37	8.37	8.37
Lignite/brown coal	8.37	8.37	8.37	8.37	8.37
Peat	8.37	8.37	8.37	8.37	8.37
Patent fuel					
Coke oven coke and lignite coke	27.21	27.21	27.21	27.21	27.21
Gas coke					
Bkb/peat briquettes	20.10	20.10	20.10	20.10	20.10
Net caloric values [GJ per tonne]	**Peru**	**Philippines**	**Qatar**	**Romania**	**Russian Federation**
Hard coal	29.31	24.33	25.75	25.57	22.83
Lignite/brown coal/sub-bituminous ~		8.37	8.37	7.95	15.91
Coking coal	29.31	20.10	25.75	27.43	22.83
Other bituminous coal/anthracite	29.31	24.33	25.75	25.25	22.83
Sub-bituminous coal		8.37	8.37	18.71	15.91
Lignite/brown coal		8.37	8.37	7.95	15.91
Peat	8.37	8.37	8.37	8.79	9.96
Patent fuel				14.65	
Coke oven coke and lignite coke	27.21	27.21	27.21	26.41	29.01
Gas coke					
Bkb/peat briquettes		20.10	20.10	14.65	17.58
Net Caloric Values [GJ per tonne]	**Saudi Arabia**	**Senegal**	**Singapore**	**Slovenia**	**South Africa**
Hard coal	25.75	25.75		17.82	27.00
Lignite/brown coal/sub-bituminous ~	8.37	8.37	8.37	9.99	
Coking coal	25.75	25.75		25.95	30.99
Other bituminous coal/anthracite	25.75	25.75		25.95	27.00
Sub-bituminous coal	8.37	8.37	8.37	17.76	
Lignite/brown coal	8.37	8.37	8.37	9.99	8.37
Peat	8.37	8.37	8.37	8.37	8.37
Patent fuel				29.31	
Coke oven coke and lignite coke	27.21	27.21	27.21	26.90	26.50
Gas coke					
Bkb/peat briquettes	20.10	20.10		20.10	20.10

Source: OECD/IEA (2001c).

Table 15
Net Caloric Values for Coal and Coal Products
Non-OECD Countries Sr-Ve

Net caloric values [GJ per tonne]	Sri Lanka	Sudan	Syrian AR	Tajikistan	Tanzania, United Rep. of
Hard coal	29.31		25.75	18.58	25.75
Lignite/brown coal/sub-bituminous ~	8.37		8.37	14.65	
Coking coal	25.75		25.75	18.58	25.75
Other bituminous coal/anthracite	29.31		25.75	18.58	25.75
Sub-bituminous coal	8.37		8.37	14.65	
Lignite/brown coal	8.37		8.37	14.65	
Peat	8.37	8.37	8.37	8.37	8.37
Patent fuel				29.31	
Coke oven coke and lignite coke	27.21	27.21	27.21	25.12	27.21
Gas coke					
Bkb/peat briquettes	20.10		20.10	20.10	

Net Caloric Values [GJ per tonne]	Thailand	Togo	Trinidad & Tobago	Tunisia	Turk-menistan
Hard coal	26.38	25.75	25.75	25.75	18.58
Lignite/brown coal/sub-bituminous ~	12.14	8.37	8.37	8.37	14.65
Coking coal	27.63	25.75	25.75	25.75	18.58
Other bituminous coal/anthracite	26.38	25.75	25.75	25.75	18.58
Sub-bituminous coal	12.14	8.37	8.37	8.37	14.65
Lignite/brown coal	12.14	8.37	8.37	8.37	14.65
Peat	8.37	8.37	8.37	8.37	8.37
Patent fuel	26.38				29.31
Coke oven coke and lignite coke	27.21	27.21	27.21	27.21	25.12
Gas coke					
Bkb/peat briquettes	20.10	20.10	20.10	20.10	20.10

Net Caloric Values [GJ per tonne]	United Arab Emirates	Ukraine	Uruguay	Uzbekistan	Venezuela
Hard coal	25.75	21.59	25.75	18.58	30.56
Lignite/brown coal/sub-bituminous ~	8.37	14.65	8.37	14.65	8.37
Coking coal	25.75	21.59	25.75	18.58	30.56
Other bituminous coal/anthracite	25.75	21.59	25.75	18.58	30.56
Sub-bituminous coal	8.37	14.65	8.37	14.65	8.37
Lignite/brown coal	8.37	14.65	8.37	14.65	8.37
Peat	8.37	8.37	8.37	8.37	8.37
Patent fuel		29.31		29.31	
Coke oven coke and lignite coke	27.21	25.12	27.21	25.12	29.30
Gas coke			27.21		
Bkb/peat briquettes	20.10	20.10	20.10	20.10	20.10

Source: OECD/IEA (2001c).

Table 16
Net Caloric Values for Coal and Coal Products
Non-OECD Countries Vi-Z

Net caloric values [GJ per tonne]	Viet Nam	Yemen	Yugoslavia, FR	Zambia	Zimbabwe
Hard coal	23.45	25.75	25.95	24.71	27.00
Lignite/brown coal/sub-bituminous ~	8.37	8.37	13.05	8.37	8.37
Coking coal	23.45	25.75	25.95	24.71	27.00
Other bituminous coal/anthracite	23.45	25.75	25.95	24.71	27.00
Sub-bituminous coal	8.37	8.37	13.05	8.37	8.37
Lignite/brown coal	8.37	8.37	13.05	8.37	8.37
Peat	8.37	8.37	8.37	8.37	8.37
Patent fuel	29.31		29.31		
Coke oven coke and lignite coke	27.21	27.21	26.90	27.21	25.12
Gas coke					
Bkb/peat briquettes	20.10	20.10	20.10	20.10	20.10

Source: OECD/IEA (2001c).

Table 17
Net Caloric Values for Coal and Coal Products
other Asia, other Africa and other Latin America

Net caloric values [GJ per tonne]	Other Africa	Other Latin America	Other Asia
Hard coal	25.75	25.75	25.75
Lignite/brown coal/sub-bituminous ~	8.37	8.37	8.37
Coking coal	25.75	25.75	25.75
Other bituminous coal/anthracite	25.75	25.75	25.75
Sub-bituminous coal	8.37	8.37	8.37
Lignite/brown coal	8.37	8.37	8.37
Peat	8.37	8.37	8.37
Patent fuel	29.31	29.31	29.31
Coke oven coke and lignite coke	27.21	27.21	27.21
Gas coke			
Bkb/peat briquettes	20.10	20.10	20.10

Source: OECD/IEA (2001c).

III.C.3.c.i.C. Gas

140. Gas includes natural gas, gas works gas (including substitute gas), coke oven gas and blast furnace gas.

141. Gas is converted into heat equivalents using the net caloric content of the energy commodity.

142. As the net caloric content varies considerably, the value as declared by the supplier should be used.

(a) If the actual net caloric value is not known but the country of origin is known these specific values from Table 18 should be applied.

(b) If no country-specific value is provided in Table 18, the default value of 34.20 MJ/m^3 should be applied.

Table 18
Gross and Net Caloric Values for Gas

Caloric values **Product**	(MJ per m^3) **Gross caloric value**	**Factor to convert gross caloric content to net**	**Net caloric value**
Natural gas (default value)	38.000	0.9	34.20
Natural gas originating from:			
Russian Federation	37.579	0.9	33.82
United States	38.416	0.9	34.57
Canada	38.130	0.9	34.32
Netherlands	33.220	0.9	29.90
United Kingdom	39.518	0.9	35.57
Indonesia	40.600	0.9	36.54
Algeria	42.000	0.9	37.80
Uzbekistan	37.889	0.9	34.10
Saudi Arabia	38.000	0.9	34.20
Norway	40.460	0.9	36.41
Gas works gas and substitute gas		0.9	> 33.50
Coke oven gas		0.9	please use
Blast furnace gas		1	specific values

Source: OECD/IEA (2001b, 2001c).

III.C.3.c.i.D. Biomass fuels

143. Biomass fuels include biochemicals, biofuels and biomass (see annex, III.C.7.b.(v))

144. Biomass fuels are converted into heat equivalents using the net caloric content of the energy commodity.

145. Net caloric values of biomass fuels vary considerably even among the same fuel type. By default the value as declared by the supplier of the energy commodity should be used. If no specific value is provided standard values listed in Table 19 should be applied.

Table 19
Typical Net Caloric Values for Biomass Fuels

Biomass fuel	Moisture content (% mcwb) (a)	Typical net calorific value (b) (MJ/kg)
Fuelwood (c)	20.0	15.0
Wood wet, freshly cut	40.0	10.9
Wood air-dry, humid zone	20.0	15.5
Wood air-dry, dry zone	15.0	16.6
Wood oven-dry	0.0	20.0
Wood charcoal	5.0	29.0
Charcoal		30.0
Dung		12.0
Bagasse	50.0	8.0
Wet	50.0	8.2
Air-dry	13.0	16.2
Agricultural waste		15.0
Other waste		11.0
Dung cakes (dried)	12.0	12.0
Coffee husks	12.0	16.0
Rice hulls (air-dry)	9.1	4.4
Wheat straw	12.0	15.2
Maize (stalk)	12.0	14.7
Maize (cobs)	11.0	15.4
Cotton gin trash	24.0	11.9
Cotton stalk	12.0	16.4
Coconut husks	40.0	9.8
Coconut shells	13.0	17.9

(a) mcwb: moisture content weight basis.
(b) Typical values to be considered as rough approximations.
(c) Assuming air-dry wood.

Source: IPCC (1996b).

III.C.3.c.(ii) Conversion Factors from Energy Source to Thermal Equivalents for other Energy Sources

146. Other energy sources, including waste, are converted into thermal equivalents using the specific net caloric content of the combusted material as indicated by the supplier. If no specific value is available, an estimate has to be made. The reporting entity shall disclose the specific values chosen and the underlying assumptions.

Box 4. Conversion Factor

One could argue that using a default conversion factor of, for example 0.35 is not very suitable as conversion processes within a specific company will in almost any case be different from the default value. So why not use the company-specific efficiency for the conversion of heat equivalent to work equivalent?

To see the effect of using a default value, see the following example in the table below. Assume that two different companies both use gas as a major energy source, which is converted into steam to propel a turbine (= work). Both purchase 1,000 kWh of electricity (= work) in addition to gas. Company A has an average efficiency of 0.2 kWh/MJ converting natural gas (= heat) into work, while company B is highly efficient with an efficiency of 0.58 kWh/MJ. Technically both need 4,000 kWh work equivalent of energy for their processes. As company B is more efficient, less gas needs to be purchased: 18,621 MJ thermal for company B compared with 54,000 MJ thermal for company A. If the actual efficiency is taken to convert the amount of gas purchased to work equivalents both will end up having used 3,000 kWh work equivalent. Assuming they have the same net value added of €10,000, they will have the same eco-efficiency, namely 0.4 kWh/€. Obviously this does not reflect the reality.

	Company A					**Company B**				
Conversion efficiency				0.2	kWh/MJ				0.58	kWh/MJ
Energy source	thermal	work				thermal	work			
Electricity		3 600	MJ	**1 000**	kWh		3 600	MJ	**1 000**	kWh
Gas	**54 000**	10 800	MJ	3 000	kWh	**18 621**	10 800	MJ	3 000	kWh
Energy requirement				4 000	KWh				4 000	kWh
Net value added				10 000	€				10 000	€
Eco-efficiency				0.4	kWh/€				0.4	kWh/€

If we start with the amount of energy purchased and then convert thermal energy to work equivalents using the proposed default factor of 0.35 kWh/MJ we get a more adequate result:

	Company A					**Company B**				
Conversion efficiency				0.35	kWh/MJ				0.35	kWh/MJ
Energy source	thermal	work				thermal	work			
Electricity		3 600	MJ	**1 000**	kWh		3 600	MJ	**1 000**	kWh
Gas	**54 000**	18 900	MJ	5 250	kWh	**18 621**	6 517	MJ	1 810	kWh
Energy requirement				6 250	KWh				2 810	kWh
Net value added				10 000	€				10 000	€
Eco-efficiency				0.63	kWh/€				0.28	kWh/€

Company A uses 5,250 kWh work equivalent of gas while company B uses 1,810 kWh work equivalent of gas. Both use 1,000 kWh electricity. The result using the default factor then would be: company A 6,250 kWh work equivalent; company B 2,810 kWh work equivalent. This perfectly reflects the real situation. The eco-efficiency of company A is 0.63 kWh/€, while company B has a much higher eco-efficiency of 0.28 kWh/€.

But why the 0.35 as the default value? Because the average efficiency of one of the most important and widely used conversion processes, the one that converts fossil fuels (= heat) to electricity (= work), is 0.35 (OECD/IEA 1997).

III.C.3.d. Conversion Factors from Thermal Equivalents to Work

147. Within this framework two different categories of energy are accounted for: heat and work. For the purpose of eco-efficiency reporting within this framework, energy should be valued by its capacity to provide work. Therefore, thermal energy needs to be converted so that it is of a quality comparable to that of energy supplied to the reporting entity in the form of work (e.g. electricity).

148. Work equivalents should be expressed in GWh; thermal equivalents should be expressed in MJ. The factor to convert MJ into GWh is 0.2778 (see annex III.C.7.c.(ii), for a complete conversion table of different energy units).

149. The conversion factor for thermal energy to work equivalents will be 0.35 (see Box 4 for the rationale).

$$GWh_{\text{work equivalent}} = 0.35 \times MJ_{\text{thermal equivalent}} \times 0.2778$$

150. Steam from whatever external source is accounted for using standard steam tables.[25]

III.C.4. Recognition of Energy

151. Energy as defined by paragraph III.C.3 should be recognized in the period in which it is:

(a) Purchased or sold;
(b) And when it is probable that the amount or value can be measured.

152. Stocks of energy commodities as defined in III.C.3 should be recognized at the beginning and at the end of an accounting period.

III.C.5. Measurement of Energy

153. The amount of energy purchased and sold should be weighed or metered.

154. Energy purchased or sold should be measured in an adequate SI unit (kWh, MJ, m^3, kg etc.).[26]

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25 Steam tables are published by various national engineering associations (e.g. "ASME International Steam Tables for Industrial Use", American Society of Mechanical Engineers 2000). Steam tables come as voluminous books and/or software packages. For that reason they are not listed in the guidelines.

26 The 11th Conférence Générale des Poids et Mesures (1960) adopted the French name *Système International d'Unités* (International System of Units, international abbreviation SI) for the recommended practical system of units of measurement. The organization in charge, the "Bureau International des Poids et Mesures", provides a list of all SI units [http://www.bipm.fr/enus/3_SI]

155. If an amount is estimated or calculated the range of uncertainty should be recorded.

156. For the purpose of eco-efficiency reporting, all energy purchased, sold or in stock shall be converted in a first step into heat equivalents (this step is obsolete when the company purchases energy in the form of work) and in a second step into work equivalents.

157. Total energy requirement is defined as purchased work equivalents minus sales of work equivalents plus/minus a decrease/increase in stocks of energy commodities expressed in work equivalents. The item energy requirement is used for the calculation of the eco-efficiency indicator "energy requirement per net value added" (see paragraph 76(b)).

III.C.6. Disclosure of Energy Use

158. An enterprise should disclose:

(a) The eco-efficiency indicator "energy requirement per unit of net value added";
(b) The accounting policies adopted for energy use;
(c) The amounts of each energy source recognized during the accounting period and the respective amounts of the previous year;
(d) The total energy requirement recognized during the accounting period and the respective amounts of the previous year expressed in work equivalents;
(e) The management's stance on energy use, the objectives and targets regarding energy use and the measures taken to achieve the targets.

An example of a disclosure of energy use is given in the annex, III.C.7.a.

III.C.7. Annex to Energy Use

III.C.7.a. Example of Disclosure of Energy Use

159. Disclosure of energy use consists of three parts:

(a) Total energy requirements (Table 20), covering energy purchased, energy sold and stocks of energy converted into heat and work equivalents;
(b) Raw data on the above flows and stocks (Table 21), covering energy purchased, energy sold and stocks of energy, including the respective conversion factors used;
(c) Accounting policy, energy policy, targets and measures (Table 20).

Table 20
Energy Requirement

Energy requirement	Heat (GJ heat eq.)*		Work (MWh work)		Total (MWh work eq.)*	
	2001	**2002**	**2001**	**2002**	**2001**	**2002**
Energy purchased						
Electricity			10 000	10 500	10 000	10 500
Natural gas	17 100	18 810			1 663	6 829
Bituminous coal (Argentina)	247 020	222 318			24 018	21 616
Bituminous coal (Brazil)	0	79 130			0	7 694
Total energy purchased	**264 120**	**320 258**	**10 000**	**10 500**	**35 680**	**41 639**
Energy sold						
Steam	50 000	60 000			4 862	5 834
Total energy sold	**50 000**	**60 000**			**4 862**	**5 834**
Stocks						
Bituminous coal (Argentina)	-12 351	24 702			-1 201	2 402
Bituminous coal (Brazil)	0	-79 130			0	-7 694
Stocks	**-12 351**	**-54 428**			**-1 201**	**-5 292**
Total energy requirement	**201 769**	**205 830**	**10 000**	**10 500**	**29 618**	**30 513**
Net value added (€)					10 000	11 000
Eco-efficiency indicator "energy requirement/net value added" (MWh/€)					**2.962**	**2.774**

** Note: e.g. = equivalent*

Table 21
Energy Flows and Stocks

Energy flows and stocks (raw data)		Amount			Conversion	
Energy purchased		**2001**	**2002**			
Electricity		10 000	10 500	kWh		
Natural gas		500 000	550 000	m3	34.2	MJ/m3
Bituminous coal (Argentina)		10 000	9 000	t	24 702	MJ/t
Bituminous coal (Brazil)		0	5 000	t	15 826	MJ/t
Energy sold						
Steam		50 000	60 000	MJ		
Stocks	31.12.00	31.12.01	31.12.02			
Bituminous coal (Argentina)	1 500	2 000	1 000	t	24 702	MJ/t
Bituminous coal (Brazil)	0	0	5 000	t	15 826	MJ/t

Table 22
Accounting Policy, Energy Policy, Targets and Measures

Accounting policy	
Energy policy	
Targets	
Measures	

III.C.7.b. Energy Sources

(Note: The following definitions are based on the definitions used by the International Energy Agency for its statistics - http://www.iea.org/stats/files/queoil.htm)

160. A fossil fuel is any naturally occurring fuel of an organic nature formed by the decomposition of plants or animals; this includes petroleum, natural gas and coal.

III.C.7.b.(i) Petroleum

161. Petroleum products are obtained from the processing of crude oil (including lease condensate) and other hydrocarbon compounds.

162. Crude oil is unrefined petroleum that reaches the surface of the ground in a liquid state. It is a mineral oil of natural origin comprising a mixture of hydrocarbons and associated impurities, such as sulphur. Its physical characteristics (density, viscosity, etc.) are highly variable. This category includes field or lease condensate recovered from associated and non-associated gas where it is commingled with the commercial crude oil stream.

163. Liquefied petroleum gases (LPG) are light saturated paraffinic hydrocarbons derived from the refinery processes, crude oil stabilization and natural gas processing plants. They consist mainly of propane (C_3H_8) and butane (C_4Hl0) or a combination of the two. They are normally liquefied under pressure for transportation and storage. Ethane is a naturally gaseous straight-chain hydrocarbon (C_2H_6) extracted from natural gas and refinery gas streams.

164. Motor gasoline exists as regular, midgrade and premium quality depending on the octane value. It consists of a mixture of light hydrocarbons distilling at between 35^{o}C and 215^{o}C. It is used as a fuel for land-based spark ignition engines. Motor gasoline may include additives, oxygenates and octane enhancers, including lead compounds such as TEL (tetraethyl lead) and TML (tetramethyl lead).

(a) Unleaded: motor gasoline where lead compounds have not been added to enhance octane rating. It may contain traces of organic lead.

(b) Leaded: motor gasoline with TEL (tetraethyl lead) and/or TML (tetramethyl lead) added to enhance octane rating.

165. Aviation gasoline is motor spirit prepared especially for aviation piston engines, with an octane number suited to the engine, a freezing point of -60°C and a distillation range within the limits of 30°C and 180°C.

166. Kerosene-type jet fuel is a distillate used for aviation turbine power units. It has the same distillation characteristics between 150°C and 300°C and flash point as kerosene. In addition, it has particular specifications, which are established by the International Air Transport Association (IATA).

167. Naphtha-type jet fuel includes all light hydrocarbon oils for use in aviation turbine power units, distilling at between 100°C and 250°C. They are obtained by blending kerosene and gasoline or naphtha in such a way that the aromatic content does not exceed 25 per cent in volume, and the vapour pressure is between 13.7kPa and 20.6kPa.

168. Kerosene comprises refined petroleum distillate and is used in sectors other than aircraft transport. It distils at between 150°C and 300°C.

169. Gas/diesel fuel is primarily a medium distillate distilling at between 180°C and 380°C. Several grades are available depending on uses: diesel oil for diesel compression ignition (cars, trucks, marine, etc.); marine diesel and diesel used in rail traffic, light heating oil. There are two qualities:

(a) Low sulphur content: sulphur content lower than 1 per cent.

(b) High sulphur content: sulphur content of 1 per cent or higher.

170. Heavy fuel oil covers all residual fuel oils (including those obtained by blending). The flash point is always above 50°C and density is always more than 0.90 kg/l.

171. Naphtha is a feedstock destined for the petrochemical industry (e.g. ethylene manufacture or aromatics production) or for gasoline production by reforming or isomerization within the refinery. Naphtha comprises material in the 30°C and 2l0°C distillation range or part of this range.

172. Petroleum coke is a black solid residue, obtained mainly by cracking and carbonizing residue feedstock, tar and pitches in processes such as delayed coking or fluid coking. It consists mainly of carbon (90 to 95 per cent) and has a low ash content. It is used as a feedstock in coke ovens for the steel industry, for heating purposes, for electrode manufacture and for production of chemicals. The two most important qualities are "green coke" and "calcinated coke". This category also includes "catalyst coke" deposited on the catalyst during refining processes; this coke is not recoverable and is usually burned as refinery fuel.

III.C.7.b.(ii) Gases

173. Natural gas is a mixture of gaseous hydrocarbons, composed primarily of methane (CH_4), occurring naturally in the earth, that is used as a fuel.

174. Gas works gas covers all types of gases, including substitute natural gas produced in a public utility or private plants, whose main purpose is manufacture, transport and distribution of gas. It includes gas produced by carbonization (including gas produced by coke ovens and transferred to gas works gas), by total gasification with or without enrichment with oil products (LPG, residual fuel oil, etc.), by cracking of natural gas, and by reforming and simple mixing of gases and/or air. This category includes substitute natural gas that is a high-calorific-value gas, manufactured by chemical conversion of a hydrocarbon fossil fuel. It is chemically and physically interchangeable with natural gas and is usually distributed through the natural gas grid. Substitute natural gas is distinguished from other manufactured gases by its high heat value (above 33.5 MJ/m^3) and by its high methane content (above 85 per cent).

175. Coke oven gas is a by-product of solid fuel carbonization and gasification operations carried out by coke producers and iron and steel plants, which are not connected with gasworks and municipal gas plants.

176. Blast furnace gas is obtained as a by-product in operating blast furnaces; it is recovered on leaving the furnaces and used partly within the plant and partly in other steel industry processes or in power stations equipped to burn it.

III.C.7.b.(iii) Coal

177. Hard coal refers to coal of gross calorific value greater than 23,865 kJ/kg on an ash-free but moist basis and with a mean random reflectance of vitrinite of at least 0.6. Hard coal comprises coking coal and other bituminous coal/anthracite:

    (a) Coking coal is a hard, dry carbon substance produced by coal at a very high temperature in the absence of air. Coking coal has a quality that allows the production of a coke suitable to support a blast furnace charge. It is therefore used in the manufacture of iron and steel.
    (b) Anthracite is the hardest coal and gives off the greatest amount of heat when it burns. It is used for steam raising and space heating purposes.
    (c) Other bituminous coal not included under coking coal. Used for steam raising and space heating purposes.

178. Sub-bituminous coal is a dull black coal. It gives off a little more energy (heat) than lignite when it burns. Non-agglomerating coals with a gross calorific value of between 17,435 kJ/kg and 23,865 kJ/kg contains more than 31 per cent volatile matter on a dry mineral matter-free basis.

179. Lignite and brown coal are non-agglomerating coals with a gross calorific value of less than 17,435 kJ/kg and greater than 31 per cent volatile matter on a dry mineral matter-free basis. The largest portion of the world's coal reserves is made up of lignite/brown coal, a soft, brownish-black coal that forms the lowest quality level of the coal family.

180. Peat is a combustible soft, porous or compressed, fossil sedimentary deposit of plant origin with high water content (up to 90 per cent in the raw state), easily cut, of light to dark brown colour.

181. Coke oven coke is the solid product obtained from carbonization of coal, principally coking coal, at high temperature; it is low in moisture and volatile matter. Coke oven coke is used mainly in the iron and steel industry acting as an energy source and chemical agent. Coke breeze, foundry coke and semi-coke (the solid product obtained from carbonization of coal at low temperature) are included in this category. Coke oven coke also includes coke and semi-coke made from lignite/brown coal.

182. Gas coke is the by-product of hard coal used for production of town gas in gas works. Gas coke is used for heating purposes.

183. Patent fuel is a composition fuel manufactured from hard coal fires by shaping with the addition of a binding agent (pitch).

184. Brown coal/peat briquettes (BKB) is a composition fuel manufactured from lignite/brown coal or peat. The lignite/brown coal is crushed, dried and moulded under high pressure into an even-shaped briquette without the addition of binders. Lignite dust is included in this category.

(Note: The following definitions are based on the National Renewable Energy Laboratory (US) definitions; http://www.nrel.gov/clean_energy/whatisRE.html)

III.C.7.b.(iv) Direct Solar Energy

185. Direct solar energy includes the following:

(a) Photovoltaic (solar cell) systems which produce electricity directly from sunlight;
(b) Concentrating solar systems that use the sun's heat to produce steam and convert it to electricity;
(c) Passive solar heating and day lighting systems that use solar energy to heat and light buildings;
(d) Solar hot water systems that heat water for other purposes than heating;
(e) Solar process heat for industrial and commercial uses, for example coffee bean drying;
(f) Solar space heating and cooling.

III.C.7.b.(v) Biomass Fuels (Biomass-Based Solar Energy)

186. Biomass fuels includes:

(a) Biochemicals

Heat is used to chemically convert biomass into a fuel oil. The chemical conversion process is called pyrolysis, and it occurs when biomass is heated in the absence of oxygen. After pyrolysis, biomass turns into a liquid – called pyrolysis oil – which can be burned like petroleum.

(b) Biofuels

Biomass is converted into liquid fuels for transportation needs. The two most common types of biofuels are ethanol (an alcohol) and biodiesel (an ester). Other biofuels include methanol and reformulated gasoline components. Methanol, commonly called wood alcohol, is produced through the gasification of biomass. After gasification, the resulting hot gas is sent through a tube and then converted into liquid methane.

(c) Biomass

Biomass is burned directly, or is converted into a gaseous fuel (e.g. methane), to generate heat, electricity or any other form of energy.

III.C.7.b.(vi) Hydropower

187. Hydropower includes:

(a) Dams

Most large-scale hydropower plants use a dam on a river to store water in a reservoir. Water released from the reservoir flows through a turbine, spinning it, which in turn activates a generator to produce electricity.

(b) River plants

Hydropower river plants use not a reservoir, but a canal to channel the river water through a turbine.

III.C.7.b.(vii) Geothermal Energy

188. Geothermal energy refers to:

(a) Production from the earth's heat;
(b) Production of heat directly from hot water within the earth;
(c) Using the shallow ground to heat and cool buildings.

III.C.7.b.(viii) Ocean Energy

189. Ocean energy conversion includes:

(a) Ocean thermal energy, which is used for many applications, including electricity generation. There are three types of electricity conversion systems: closed-cycle, open-cycle and hybrid. Closed-cycle systems use the ocean's warm surface water to vaporize a working fluid, which has a low-boiling point, such as ammonia. The vapour expands and turns a turbine. The turbine then activates a generator to produce electricity. Open-cycle systems actually boil the seawater by operating at low pressures. This produces steam that passes through a turbine/generator. Hybrid systems combine both closed-cycle and open-cycle systems.

(b) Ocean mechanical energy conversion includes:

Ocean mechanical energy, which is quite different from ocean thermal energy. Even though the sun affects all ocean activity, tides are driven primarily by the gravitational pull of the moon, and waves are driven primarily by the winds. As a result, tides and waves are intermittent sources of energy, while ocean thermal energy is fairly constant. Also, unlike in the case of thermal energy, the electricity conversion of both tidal and wave energy usually involves mechanical devices.

(i) Wave Energy

For wave energy conversion, there are three basic systems: channel systems that funnel the waves into reservoirs; float systems that drive hydraulic pumps; and oscillating water column systems that use the waves to compress air within a container. The mechanical power created from these systems either directly activates a generator or transfers to a working fluid, water, or air, which then drives a turbine/generator.

(ii) Tidal Energy

A barrage (dam) is typically used to convert tidal energy into electricity by forcing the water through turbines, activating a generator.

III.C.7.c. Units and Conversions

III.C.7.c.(i) Decimal Prefixes

Prefix	Symbol	Factor	
exa	E	10^{18}	1,000,000,000,000,000,000
peta	P	10^{15}	1,000,000,000,000,000
tera	T	10^{12}	1,000,000,000,000
giga	G	10^{9}	1,000,000,000
mega	M	10^{6}	1,000,000
kilo	kg	10^{3}	1,000
hecto	h	10^{2}	100
deca	da	10^{1}	10
deci	d	10^{-1}	0.1
centi	c	10^{-2}	0.01
mili	m	10^{-3}	0.001
micro	µ	10^{-6}	0.000,001
nano	n	10^{-9}	0.000,000,001
pico	p	10^{-12}	0.000,000,000,001
femto	f	10^{-15}	0.000,000,000,000,001
atto	a	10^{-18}	0.000,000,000,000,000,001

III.C.7.c.(ii) General Conversion Factors for Energy

(2) to:	**TJ**	**Gcal**	**Mtoe**	**MBtu**	**GWh**
(1) from:	*(3) multiply by:*				
TJ	1	238.8	2.388×10^{-5}	947.8	0.2778
Gcal	4.1868×10^{-3}	1	10^{-7}	3.968	1.163×10^{-3}
Mtoe	4.1868×10^{4}	10^{7}	1	3.968×10^{7}	11630
MBtu	1.0551×10^{-3}	0.252	2.52×10^{-8}	1	2.931×10^{-4}
GWh	3.6	860	8.6×10^{-5}	3412	1

III.C.7.c.(iii) General Conversion Factors for Volume

(2) to:	**gal US**	**gal UK**	**bbl**	**ft^3**	**l**	**m^3**
(1) from:	*(3) multiply by:*					
gal US	1	0.8327	0.02381	0.1337	3.785	0.0038
gal UK	1.201	1	0.02859	0.1605	4.546	0.0045
bbl	42	34.97	1	5.615	159	0.159
ft^3	7.48	6.229	0.1781	1	28.3	0.283
l	0.2642	0.220	0.0063	0.0353	1	0.001
m^3	264.2	220	6.289	35.3147	1000	1

III.C.7.c.(iv) General Conversion Factors for Mass

2) to: *1) from:*	**kg** *3) multiply by:*	**t**	**lt**	**st**	**lb**
kg	1	0.001	9.84×10^{-4}	1.102×10^{-3}	2.2046
t	1000	1	0.984	1.1023	2204.6
lt	1016	1.016	1	1.120	240
st	907.2	0.9072	0.893	1	2000
lb	0.454	4.54×10^{-4}	4.46×10^{-4}	5×10^{-4}	1

III.D. Accounting Treatment of Global Warming Contribution

III.D.1. Objective

190. The objective of this manual is to provide guidance regarding the accounting treatment of the global warming contribution of an enterprise.

III.D.2. Scope

191. This guidance should be applied in accounting for substances that contribute to global warming and which are listed under the Kyoto Protocol/Convention.

192. This manual does not deal with specific aspects of energy-producing enterprises (see the definition in the guideline for energy use in III.C.2), agricultural activities and forestry. These industries should use this manual on global warming contribution with care. A specific guideline on the global warming contribution by energy-producing companies, the agricultural sector and forestry needs to be developed.

III.D.3. Definitions

III.D.3.a. Global Warming Gases

193. Global warming gases are all gases that are listed under the Kyoto Protocol/Convention (the protocol):

(a) Carbon dioxide (CO_2);
(b) Methane (CH_4);
(c) Nitrous oxide (N_2O);
(d) Sulphur hexafluoride (SF_6);
(e) Perfluorocarbons (PFCs) and;
(f) Hydrofluorocarbons HFCs.

194. If a enterprise produces, uses or emits other substances that contribute to global warming other than the ones listed in the protocol and these gases make a significant contribution to the total global warming contribution of the reporting entity, they should be included.

195. The contribution of a gas is considered significant when its share of the total global warming contribution of the company exceeds 1 per cent.

III.D.3.b. Global Warming Potential

196. Global warming potential is the assumed impact of a substance on global warming. Global warming potentials are based on current scientific knowledge and are expressed in kg carbon dioxide (CO_2) equivalents per kg of the substance. The values are listed in Table 34.

197. Global warming potentials are dependent on the time frame: the longer the period, the longer a substance is potentially able to contribute to global warming. Global warming potentials can be expressed in a 500-year time frame. For the purpose of this manual the values for the 100-year time frame are used.

III.D.3.c. Global Warming Contribution

198. Global warming contribution is the amount of global warming gases (kg per year) multiplied by their respective global warming potential (kg CO_2/kg and year). It is expressed in kg carbon dioxide (CO_2) equivalents per year.

199. The total global warming contribution of an enterprise is used as an indicator for the effect the enterprise has on an increase in global temperature.

III.D.3.d. Energy- and Transport-Related Global Warming Gases

200. For practical reasons, energy- and transport-related global warming impacts are reduced to CO_2 emissions caused by the use of non-renewable energy sources, including electricity suppliers. Renewable energy is assumed to have no global warming contribution.[27]

201. For the time being, other global warming gases stemming from the use of energy and transport services (e.g. methane) are not considered.

202. The amount of non-renewable energy and electricity used is based on the energy requirement as recognized using the guideline on energy use (III.C).

203. CO_2 emissions stemming from the use of fossil fuels are derived from the carbon content of the fuel. It is assumed that all carbon is oxidized to CO_2 and no carbon is stored in residuals (e.g. ashes). A list of different fuels and the respective CO_2 emissions is provided in Table 23.

204. Electricity derived CO_2 emissions are based on the technology and fuels used in a specific country – the so-called electricity-mix. Values are derived from data provided by the International Energy Agency. A country list is provided in Table 25.

III.D.3.e. Global Warming Gases Related to Other Industrial Processes

205. Process-related and other global warming gases are all global warming gases caused by non-energy and non-transport processes. Examples include cement production, waste incineration and others. Agricultural activities such as rice farming and cattle breeding also fall into this category. However, these are not dealt with specifically in this manual (see paragraph 192).

[27] We are well aware that - when taking the whole product life cycle of renewable energy sources/systems into account – renewable energy sources are not 100 per cent free of global warming gas emissions.

III.D.4. Recognition of Global Warming Gases

III.D.4.a. In General

206. Global warming gases should be recognized in the period in which they are emitted.

207. Energy- and transport-related global warming gases are recognised when the underlying energy is recognized (see the guideline on energy use, III.C.3.d).

208. For the purpose of eco-efficiency reporting, only the amount of CO_2 linked to the use of energy is recognized.[28]

209. Global warming gases relating to other industrial processes are only recognized when these gases contribute significantly to the total global warming contribution of the reporting entity.

210. The contribution of a gas is considered significant when its share of the total contribution of the company exceeds 1 per cent.

III.D.4.b. Carbon Offset and Sequestration

211. Carbon offset/sequestration programmes undertaken by the reporting entity, based either on the Clean Development Mechanism (CDM), on Activities Jointly Implemented (AJI) or on similar initiatives, are recognized when the following conditions are met:

(a) The programme does not violate the development objectives, economic priorities and regulations of the country of the participating party;

(b) The programme is an additional component and not business as usual (= baseline). Besides a clear statement of intent to reduce global warming contribution, the additional component should be demonstrated by using historical data, future trends and financial aspects (usually the aspect of carbon offset adds additional costs to a project compared with the baseline);

(c) The programme does not cause negative externalities.[29]

(d) The programme is supplied with sufficient financial and managerial capacity and has the appropriate infrastructure and technological support;

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[28] CO_2 emissions are related to the carbon content of the fuel, while other energy-linked global warming gases (e.g. methane, non-methane volatile organic compounds) depend on the technology used.

[29] Examples of global warming-related externalities include: activities simply shifting to other areas, outsourcing activities which were once done on-site, market incentives which lead to an increase in emissions elsewhere, programme-induced changes in up- or downstream processes leading to higher emissions. Examples of non-global-warming-related externalities include: negative impacts on biodiversity, hydrology, chemical usage, waste disposal, economic development, gender issues, capacity building etc.

(e) The programme is monitored continuously and data on its carbon effect are collected on a yearly basis within an acceptable level of certainty;

(f) An independent body reviews the above criteria and a recognized national or international certification body certifies the effect.

212. If the above conditions are met the offset or sequestrated amount of global warming gases can be deducted.

III.D.5. Measurement

III.D.5.a. General Approach

213. The measurement of global warming contribution is mainly a matter of calculations. It consists of the following steps:

(a) First step: The total energy requirement as defined by the guideline on energy use is determined (see III.C).

(b) Second step: The amount of energy expressed in heat equivalents is converted to CO_2 emissions (the amount of CO_2 linked to the use of non-renewable energy sources is listed in Table 23).

(c) Third step: The amount of electricity expressed in work equivalents is converted to CO_2 emissions (the amount of CO_2 linked to the use of electricity for different countries is listed in Table 25).

(d) Fourth step: Significant global warming gases relating to other industrial processes are included.

(e) Fifth step: The amounts of the different global warming gases are multiplied by their respective global warming potential to arrive at the global warming contribution of the reporting entity.

Table 23
CO_2 Emission Factors of
Petroleum Products, Coal and Coal Products, Gas and Biomass Fuels

Fuel carbon emission	Carbon content (t C/TJ)		Carbon emission factor (t CO2/TJ)
Petroleum products			
Ethane	16.80		61.60
Lpg	17.20		63.07
Naphtha	20.00	(a)	73.33
Aviation gasoline			
Motor gasoline	18.90		69.30
Jet gasoline			
Jet kerosene	19.50		71.50
Other kerosene	19.60		71.87
Gas/diesel fuel	20.20		74.07
Heavy fuel oil/residual fuel oil	21.20		77.73
Petroleum coke	27.50		100.83
Coal and coal products			
Coking coal	25.80		94.60
Other bituminous coal	25.80		94.60
Anthracite	26.80		98.27
Sub-bituminous coal	26.20		96.07
Lignite / brown coal	27.60		101.20
Peat	28.90		105.97
Patent fuel	25.80	(a)	94.60
Coke oven coke	29.50		108.17
Gas coke	29.50		108.17
Bkb/peat briquettes	25.80	(a)	94.60
Gas			
Natural gas (dry)	15.30		56.10
Gas works gas			
Coke oven gas	13.00		47.67
Blast furnace gas	66.00		242.00

Note: The carbon ("C") content is multiplied with the molecular weight ratio of CO_2 to C, (44/12). It is assumed that all carbon is oxidized.

a) This value is a default value until a fuel-specific CEF is determined. For gas biomass, the carbon emission factor is based on the assumption that 50 per cent of the carbon in the biomass is converted to methane and 50 per cent is emitted as CO_2. If biogas is released and not combusted, 50 per cent of the carbon content should be included as methane.

III.D.5.b. CO_2-Emission Factors for Fossil Fuels

214. CO_2-emission factors of petroleum products, coal and coal products, gas and biomass fuels (Table 23) are based on data provided by IPCC and are used for national greenhouse gas inventories (IPCC 1996b).

III.D.5.c. CO_2-Emission Factors for Electricity

215. Electricity-derived CO_2-emission factors are based on IEA data. Whenever country-specific factors are known these should be used.

216. The factors in Table 24 to Table 33 have been calculated by taking CO_2 emissions from public electricity and heat production (OECD/IEA 2001a) which incorporate emissions from public electricity generation, public combined heat and power generation and public heat plants. Total emissions are then divided by the total electricity production (OECD/IEA 2001b) including electricity from nuclear power and renewables, which are assumed to have zero CO_2 emissions, to arrive at an emission factor of tonnes of CO_2 per kWh of electricity produced.

Table 24
Electricity-derived CO_2-Emission Factors for Non-OECD Asia

Asia (Non-OECD)	t CO_2/kWh
Bangladesh	0.000593
Brunei	0.000797
China, People's Republic of	0.001007
Taiwan (POC)	0.000533
Hong Kong, China	0.000690
India	0.000836
Indonesia	0.000621
Korea, DPR	0.000989
Malaysia	0.000440
Myanmar	0.000556
Nepal	0.000033
Pakistan	0.000410
Philippines	0.000486
Singapore	0.000956
Sri Lanka	0.000210
Thailand	0.000603
Viet Nam	0.000325
Other Asia	0.000232
(Afghanistan, Bhutan, Fiji, French Polynesia, Kiribati, Maldives, New Caledonia, Papua New Guinea, Samoa, Solomon Islands and Vanuatu)	

Table 25
Electricity-derived CO_2-Emission Factors for Africa

Africa	t CO_2/kWh
Algeria	0.000687
Angola	0.000328
Benin	0.000938
Cameroon	0.000952
Congo, Republic of	0.000000
Congo, Democratic Republic of the	0.000004
Côte d'Ivoire	0.000674
Egypt	0.000480
Eritrea	0.000683
Ethiopia	0.000024
Gabon	0.000256
Ghana	0.000189
Kenya	0.000250
Libyan Arab Jamahiriya	0.000632
Morocco	0.000739
Mozambique	0.000001
Namibia	0.000017
Nigeria	0.000365
Senegal	0.000920
South Africa	0.000862
Sudan	0.000447
Tanzania, United Republic of	0.000035
Togo	0.001154
Tunisia	0.000564
Yemen	0.000558
Zambia	0.000000
Zimbabwe	0.000779
Other Africa	0.000629
(Botswana, Burkina Faso, Burundi, Cape Verde, Central African Republic, Chad, Djibouti, Equatorial Guinea, Gambia, Guinea, Guinea-Bissau, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Niger, Rwanda, Sao Tome and Principe, Seychelles, Sierra Leone, Somalia, Swaziland and Uganda)	

Table 26
Electricity-derived CO_2-Emission Factors for Non-OECD Europe

Europe (Non-OECD)	t CO_2/kWh
Albania	0.000021
Bosnia-Herzegovina	0.001572
Bulgaria	0.000685
Croatia	0.000418
Cyprus	0.000860
Gibraltar	0.001613
Macedonia, Former Yugoslav Republic of	0.000908
Malta	0.000971
Romania	0.001120
Slovenia	0.000640
Yugoslavia, Federal Republic of	0.001689

Table 27
Electricity-derived CO_2-Emission Factors for Non-OECD Former USSR

Former USSR (Non-OECD)	t CO_2/kWh
Armenia	0.000442
Azerbaijan	0.009216
Belarus	0.001677
Estonia	0.001476
Georgia	0.000140
Kazakhstan	0.009002
Kyrgyzstan	0.000136
Latvia	0.000976
Lithuania	0.011594
Moldova, Republic of	0.000992
Russian Federation	0.001760
Tajikistan	0.000045
Turkmenistan	1.744000
Ukraine	0.001317
Uzbekistan	0.001296

Table 28
Electricity-derived CO_2-Emission Factors for Non-OECD Latin America

Latin America (non-OECD)	t CO_2/kWh
Argentina	0.000343
Bolivia	0.000482
Brazil	0.000057
Chile	0.000461
Colombia	0.000104
Costa Rica	0.000024
Cuba	0.000863
Dominican Republic	0.000655
Ecuador	0.000231
El Salvador	0.000269
Guatemala	0.000214
Haiti	0.000415
Honduras	0.000260
Jamaica	0.000676
Netherlands Antilles	0.000746
Nicaragua	0.000585
Panama	0.000262
Paraguay	0.000000
Peru	0.000131
Trinidad and Tobago	0.000696
Uruguay	0.000187
Venezuela	0.000191
Other Latin America (Antigua and Barbuda, Bahamas, Barbados, Belize, Bermuda, Dominica, French Guiana, Grenada, Guadeloupe, Guyana, Martinique, Saint Kitts and Nevis and Anguilla, Saint Lucia, Saint Vincent and the Grenadines and Suriname)	0.000455

Table 29
Electricity-derived CO_2-Emission Factors for Middle East

Middle East	t CO_2/kWh
Bahrain	0.000851
Iran, Islamic Republic of	0.000580
Iraq	0.000544
Israel	0.000823
Jordan	0.000737
Kuwait	0.000672
Lebanon	0.000815
Oman	0.000745
Qatar	0.001104
Saudi Arabia	0.000476
Syrian Arab Republic	0.000565
United Arab Emirates	0.000762

Table 30
Electricity-derived CO_2-Emission Factors for OECD Europe

Europe (OECD)	t CO_2/kWh
Austria	0.000157
Belgium	0.000254
Denmark	0.000639
Finland	0.000259
France	0.000048
Germany	0.000498
Greece	0.000841
Ireland	0.000699
Italy	0.000375
Luxembourg	0.000000
Netherlands	0.000540
Portugal	0.000497
Spain	0.000373
Sweden	0.000045
United Kingdom	0.000394
Czech Republic	0.000808
Hungary	0.000705
Iceland	0.000004
Norway	0.000002
Poland	0.001082
Slovak Republic	0.000372
Switzerland	0.000002
Turkey	0.000487

Table 31
Electricity-derived CO_2-Emission Factors for North America

North America	**t CO_2/kWh**
Mexico	0.000527
Canada	0.000196
United States	0.000514

Table 32
Electricity-derived CO_2-Emission Factors for OECD Asia-Pacific

Asia-Pacific (OECD)	**t CO_2/kWh**
Japan	0.000297
Republic of Korea	0.000356
Australia	0.000819
New Zealand	0.000124

Table 33
Electricity-derived CO_2-Emission Factors for World Regions

World Regions	**t CO_2/kWh**
World	0.000540
Africa	0.000663
Latin America	0.000169
Asia excluding China	0.000683
China	0.001007
Former USSR	0.001653
Middle East	0.000616
OECD total	0.000420
OECD North America	0.000476
OECD Pacific	0.000371
OECD Europe	0.000362
Non-OECD Europe	0.000912
Non-OECD total	0.000792
European Union	0.000349

III.D.5.d. Global Warming Gases Related to Other Industrial Processes

217. The amount of global warming gases related to other industrial processes should be metered.

218. If an amount is estimated or calculated the range of uncertainty should be recorded.

III.D.5.e. Calculating Global Warming Contribution

219. To arrive at the global warming contribution pertaining to the activities of the enterprise, the amounts of global warming gases are multiplied by their respective global warming potentials.

220. Table 34 and Table 35 provide values for the main global warming gases and groups of global warming gases.

221. Where the actual substance is not known but the substance group is known the highest value of that group should be applied.

222. The item "global warming contribution" is used for the calculation of the eco-efficiency indicator "global warming contribution per unit of net value added" (see paragraph 76(c)).

Table 34
Global Warming Potentials Part I

Global warming gas		**Lifetime (years)**	**Global Warming Potential (100 years)**
Carbon dioxide		(kg CO_2-equivalent per kg carbon dioxide)	
Carbon dioxide	CO_2		1
Methane		(kg CO_2-equivalent per kg methane)	
Methane	CH_4	12.0	23
Nitrous oxide		(kg CO_2-equivalent per kg nitrous oxide)	
Nitrous oxide	N_2O	114	296
Hydrofluorocarbons		(kg CO_2-equivalent per kg hydrofluorocarbons)	
HFC-23	CHF_3	260.0	12 000
HFC-32	CH_2F_2	5.0	550
HFC-41	CH_3F	2.6	97
HFC-125	CHF_2CF_3	29.0	3 400
HFC-134	CHF_2CHF_2	9.6	1 100
HFC-134a	CH_2FCF_3	13.8	1 300
HFC-143	CHF_2CH_2F	3.4	330
HFC-143a	CF_3CH_3	52.0	4 300
HFC-152	CH_2FCH2F	0.5	43
HFC-152a	CH_3CHF2	1.4	120
HFC-161	CH_3CH_2F	0.3	12
HFC-227ea	CF_3CHFCF_3	33.0	3 500
HFC-236cb	$CH_2FCF_2CF_3$	13.2	1 300
HFC-236ea	CHF_2CHFCF_3	10.0	1 200
HFC-236fa	$CF_3CH_2CF_3$	220.0	9 400
HFC-245ca	$CH_2FCF_2CHF_2$	5.9	640
HFC-245fa	$CHF_2CH_2CF_3$	7.2	950
HFC-365mfc	$CF_3CH_2CF_2CH_3$	9.9	890
HFC-43-10mee	$CF_3CHFCHFCF_2CF_3$	15.0	1 500
Fully fluorinated species		(kg CO_2-equivalent per kg sulphur hexafluoride)	
SF_6		3 200	22 600
CF_4		50 000	5 700
C_2F_6		10 000	11 900
C_3F_8		2 600	8 600
C_4F_{10}		2 600	8 600
c-C_4F_8		3 200	10 000
C_5F_{12}		4 100	8 900
C_6F_{14}		3 200	9 000

Source: IPCC (2001).

Table 35
Global Warming Potentials Part II

Global warming gas		Lifetime (years)	Global warming potential (100 years)
Ethers and halogenated ethers		(kg CO_2-equivalent per kg per fluorocarbons)	
$CH_{3O}CH_3$		0.015	1
HFE-125	$CF_{3O}CHF_2$	150	14900
HFE-134	$CHF_{2O}CHF_2$	26.2	6100
HFE-143a	$CH_{3O}CF_3$	4.4	750
HCFE-235da2	$CF_3CHClOCHF_2$	2.6	340
HFE-245fa2	$CF_3CH2OCHF_2$	4.4	570
HFE-254cb2	$CHF_2CF_2OCH_3$	0.22	30
HFE-7100	$C_4F_9OCH_3$	5.0	390
HFE-7200	$C_4F_9OC_2H_5$	0.77	55
H-Galden 1040x	$CHF_2OCF_2OC_2F_4OCHF_2$	6.3	1800
HG-10	$CHF_2OCF_2OCHF_2$	12.1	2700
HG-01	$CHF_2OCF_2CF_2OCHF_2$	6.2	1500

Source: IPCC (2001).

III.D.6. Disclosure of global warming gases

223. An enterprise should disclose:

(a) The eco-efficiency indicator "global warming contribution per unit of net value added";

(b) The accounting policies adopted for global warming gases;

(c) The amount of each category of global warming gas recognized during the accounting period and the respective amounts of the previous year;

(d) The total global warming contribution during the accounting period and the respective amounts of the previous year;

(e) The management's stance on energy use, the objectives and targets regarding global warming and the measures taken to achieve the targets.

An example of a disclosure of global warming contribution is given in the annex, III.D.7.a.

III.D.7. Annex to Global Warming Contribution

III.D.7.a. Example of a Disclosure of Global Warming Contribution

224. A disclosure on global warming contribution consists of two parts:

(a) Global warming contributions (Table 36) caused by CO_2-emissons related to energy use and other global warming gases caused by other industrial energy processes;

(b) Accounting policy on global warming gases, global warming policy, targets and measures (Table 37).

Table 36
Global Warming Contribution

CO_2 emissions related to energy use	**Energy requirement 2001**	**Energy requirement 2002**		**Global warming contribution (100 y) 2001**	**Global warming contribution (100 y) 2002**	
Electricity (Germany)	10 000 000	11 000 000	MWh	4 980 000	5 478 000	(t CO_2)
Electricity (Switzerland)	20 000 000	25 000 000	MWh	40 000	50 000	(t CO_2)
Natural gas (dry)	1 700	2 000	GJ	95 370 000	112 200 000	(t CO_2)
Bituminous coal	2 000	2 200	GJ	189 200 000	208 120 000	(t CO_2)
Motor gasoline	500	600	GJ	34 650 000	41 580 000	(t CO_2)
Energy derived global warming contribution				**324 240 000**	**367 428 000**	(t CO_2)
Other industrial Processes Other global warming gases	**2001**	**2002**	**Global Warming Potential (GWP) kg CO_2-eq./kg**			
Sulphur hexafluoride (t)	3'000	2'800	22'600	67 800 000	63 280 000	(t CO_2-eq)
Other global warming gases				**67 800 000**	**63 280 000**	(t CO_2-eq)
Total global warming contribution				**392 040 000**	**430 708 000**	**(t CO_2-eq)**
Net value added				10 000 000	11 000 000	(€)
Eco-efficiency indicator "global warming contribution/net value added"				**39.204**	**39.155**	**(t CO_2-eq/€)**

Table 37
Accounting Policy on Global Warming Gases,
Global Warming Policy, Targets and Measures

Accounting policy	
Energy policy	
Targets	
Measures	

III.D.7.b. Energy Supply

225. For the purpose of accounting for global warming gases, energy supply is divided into two broad categories; energy supply that is based on renewable energy sources and energy supply based on non-renewable energy sources.

III.D.7.b.(i) Renewable Energy

226. Renewable energy refers to any energy resource that is naturally regenerated over a short time scale and derived directly or indirectly from the sun, or from other natural movements and mechanisms of the environment.

227. Renewable energy is divided into the following sub-categories according to its source (for a more detailed description see III.C.7.b):

(a) Direct solar energy (see III.C.7.b.(v));
(b) Wind energy (see III.C.7.b.(v));
(c) Biomass energy (see III.C.7.b.(v));
(d) Hydropower (see III.C.7.b.(vi));
(e) Geothermal energy (see III.C.7.b.(vii));
(f) Ocean thermal and mechanical energy (see III.C.7.b.(viii));
(g) All other energy sources (including waste) are considered to be non-renewable.

III.D.7.b.(ii) Non-Renewable Energy

228. Non-renewable energy refers to any energy resource that is either not replaced or is replaced very slowly by natural processes.

229. Non-renewable energy is divided into the following sub-categories according to its source (for a more detailed description see III.C.7.b):

(a) Petroleum

Including: liquefied petroleum gases and ethane, motor gasoline, aviation gasoline, jet fuels, kerosene, gas/diesel fuel, heavy fuel oil, naphtha, petroleum coke.[30]

(b) Gas

Including: natural gas, gas works gas and substitute gas, coke oven gas, blast furnace gas.

[30] Non-energy refined petroleum products used such as white spirit, industrial spirit, lubricating oils and grease, bitumen (asphalt), paraffin waxes, mineral oils and other non-energy petroleum products are not considered energy use.

(c) Coal and coal products

Including: coking coal (hard coal), bituminous coal and anthracite (hard coal), sub-bituminous coal, lignite and brown coal, peat, coke oven coke, gas coke, patent fuel and brown coal/peat briquettes (BKB).

(d) Nuclear fuels

Within the scope of this guideline (energy sector is excluded) nuclear fuels are not considered an energy source and therefore not taken into account as a source of global warming gases (see also the guideline on energy use, III.C.3.c).

230. All other energy sources not listed in the above paragraph and not defined as renewable are considered "other non-renewable energy".

III.E. Accounting Treatment of Ozone-Depleting Substances

III.E.1. Objective

231. The objective of this manual is to provide guidance regarding the accounting treatment of ozone-depleting substances.

III.E.2. Scope

232. This guidance should be applied by enterprises in accounting for all ozone-depleting substances which are:

(a) Defined in this manual; and
(b) Can be influenced by an enterprise through specific measures and programmes.

III.E.3. Definitions

233. The terms used in this manual are defined as follows.[31]

III.E.3.a. Ozone-Depleting Substances, Potentials and Contributions

234. Ozone-depleting substances (ODS) are all bulk chemicals/substances – existing either as a pure substance or as a mixture – that are controlled under the Montreal Protocol; that is, they are listed in Annex A, B, C or E of the Protocol. For illustrative purposes a list is provided in III.E.7.a.

235. Ozone-depleting potential (ODP) is an assigned value indicating a substance's impact on the stratospheric ozone layer per unit mass of a gas, as compared with the same mass of CFC-11 ($CFCl_3$). Ozone-depleting potential values are listed in Annex A, B, C or E of the Protocol. For illustrative purposes a list is provided in III.E.7.a.

236. Ozone-depleting contribution (ODC) is calculated by multiplying the amount of an ozone-depleting substance by the ozone-depleting potential of that substance (see Box 5). The result indicates the contribution of the amount of that substance to the depletion of the ozone layer expressed in CFC-11 equivalents.

[31] Also see UNEP 1999.

Box 5. How to Calculate the Ozone-Depleting Contribution

All substances having an ozone-depleting potential above zero are, in principle, ozone-depleting substances. These are generally chemicals containing chlorine and/or bromine. The most important ozone-depleting substances are controlled under the Montreal Protocol. A limited number of ozone-depleting substances are not yet controlled under the Protocol because they have not been produced or consumed in significant quantities.

In the Annex of the Montreal Protocol every substance controlled is listed together with a value expressing the ozone depletion potential. An ozone depletion potential value indicates how much impact a certain substance has on the depletion of the ozone layer relative to a reference substance. The reference substance normally taken is CFC-11 with an ozone depletion potential of 1; therefore, ozone depletion potential values are expressed in kg CFC-11 equivalents per kg of the respective substance.

Example: The ozone-depleting substance Halon-1211 is listed with an ozone depletion potential of 3. Assume a company uses 100 kg of halon-1211 during a reporting period. How much is the ozone-depleting contribution of this specific halon use? The answer is quite simple: multiply the amount of halon-1211 (100 kg) by the ozone depletion potential value of 3 (kg CFC-11 equivalent/kg halon-1211) to come to the ozone depletion contribution (ODC) of 300 kg CFC-11 equivalent. This means that 100 kg of halon-1211 has the same impact on the depletion of the ozone layer as 300 kg CFC-11.

III.E.3.b. Forms of Existence of ODS

237. Ozone-depleting substances can exist in two forms:

(a) Ozone-depleting substances which exist as part of a "use system".
A variety of goods and equipment contain ozone-depleting substances, be it liquid or gaseous (for examples see annex, III.E.7.c). Ozone-depleting substances are considered part of a use system when the product is applied directly to realize its intended use and is not contained in a container used for storage or transport of the substance; a refrigerator or a fire extinguisher are examples of a use system. Ozone-depleting substances that are part of a use system can be separated from the product by a special purpose recovery process (e.g. foam) or by a release valve (e.g. refrigerator). Such substances are considered to be embodied in goods or equipment.

(b) Ozone-depleting substances which exist as a substance
Ozone-depleting substances are sold as pure substances or as mixtures (blends). A pure controlled substance contains only one ozone-depleting substance. Mixtures are chemicals which contain two or more ozone-depleting substances or one or more ozone-depleting substances mixed with other non-ozone-depleting chemicals (see Box 6). Containers are not considered products.

Box 6. Mixtures

A number of mixtures containing different ODS have been introduced as replacements for pure ODS. In particular, a large number of ODS mixtures used as refrigerants and solvents exist. For example, R-406A contains 55 per cent HCFC-22, 41 per cent HCFC-142b and 4 per cent HC-600a. If the company purchases 1.5 tons of R-406A, this would add 0.825 tons to the HCFC-22 figure (1.5 multiplied by 0.55) and 0.615 tons to the HCFC-142b figure (1.5 multiplied by 0.41). Hydrocarbon 600a is not an ODS and does not need to be reported.

Source: UNEP (1999).

III.E.3.c. Types of ODS

238. Ozone-depleting substances are considered new (virgin, unused), when they are manufactured using ODS which are *not* recovered, reclaimed or recycled. In other words, any ozone-depleting substance that has not been recovered, reclaimed or recycled prior to use is a new substance.

239. Ozone-depleting substances are considered reused if they have been recovered, reclaimed and/or recycled as defined in III.E.3.h.

III.E.3.d. Production of ODS

240. Production of ozone-depleting substances means literally the amount of virgin ozone-depleting substances added by the reporting entity.

241. The following operations of the reporting entity cannot be considered as producing ozone-depleting substances:

(a) Recovery, reclamation and recycling of ozone-depleting substances

(b) Feedstock use of ozone-depleting substances

Ozone-depleting substances that are used in the manufacture of other chemicals and are completely transformed in the process are defined as feedstock. For example, carbon tetrachloride is commonly used in the production of CFCs.

(c) Process agents

Ozone-depleting substances are considered process agents, when they are used in the production of other chemicals, for example as a catalyst or an inhibitor of a chemical reaction, without being consumed.[32]

[32] Consumption equals production plus imports minus exports of controlled substances.

III.E.3.e. Purchase of ODS

242. ODS are purchased in many different forms:

(a) Ozone-depleting substances embodied in supplied goods

Any ozone-depleting substances embodied in a use system as defined in paragraph 237(a) and used to deliver a certain feature for a product that is sold, be it purchased or manufactured. Goods are considered supplied when they are purchased by the reporting entity from third parties.

(b) Ozone-depleting substances embodied in equipment for own use

Any ozone-depleting substances embodied in the reporting entity's equipment as defined in paragraph 237(a) that a company receives from third parties and is used to deliver a certain feature for the reporting entity's own equipment. Equipment is considered to be a company's own when the entity that operates the equipment is part of the same legal entity or is consolidated in the financial statement of the group (for consolidation issues see I.A).

(c) Ozone-depleting substances embodied in traded goods

Any ozone-depleting substance embodied as defined in paragraph 237(a) in traded goods and used to deliver a certain feature either for the reporting entity or for third parties. Goods are considered traded when the reporting entity sells supplied goods leaving them unchanged. Repackaging is not considered a change of product.

(d) Ozone-depleting substances as substances for goods manufactured

Any ozone-depleting substance existing either as a pure substance or a mixture (as defined in paragraph 237(b)) that a company receives from third parties and which is used to deliver a certain feature for the reporting entity's manufactured goods. A good is considered to be manufactured when the reporting entity processes raw materials, other manufactured and semi-manufactured goods into a finished product using technical know-how, equipment and energy with the purpose of selling the product to a third party.

(e) Ozone-depleting substances as substances for own production process

Any ozone-depleting substance as defined in paragraph 237(b) that a company receives from third parties and which is used to deliver a certain feature for the reporting entity's own production process. A process is considered to be a company's own when the entity that operates the process is part of the same legal entity or is consolidated in the financial statement of the group (for consolidation issues see I.A).

(f) Ozone-depleting substances as substances for own equipment

Any ozone-depleting substance as defined in paragraph 237(b) that a enterprise receives from third parties and is used to deliver a certain feature for the reporting entity's own equipment. Equipment is considered to be a enterprise's own when the entity that operates the equipment is part of the same legal entity or is consolidated in the financial statement of the group (for consolidation issues see I.A).

(g) Ozone-depleting substances as substance for trade

Any ozone-depleting substances as defined in paragraph 237(b) and used to deliver a certain feature either for the reporting entity or for third parties. Substances are considered traded when the reporting entity sells supplied substances leaving them unchanged. Repackaging is not considered a change of a substance.

III.E.3.f. Stocks of ODS

243. Stocks are defined as any ozone-depleting substance stored or accumulated on the reporting entity's premises for use, reclaim, recovery, recycling or destruction in the future.

244. Stocks include ozone-depleting substances in containers, in goods, in own equipment and in use as process agents.

III.E.3.g. Dependency on ODS

245. The dependency of an enterprise on ozone-depleting substances is defined as production plus purchases and stocks.

246. The item "dependency on ozone-depleting substances" is used for the calculation of the eco-efficiency indicator "dependency on ODS per net value added" (see paragraph 76(d)).

III.E.3.h. Recovery, Reclamation and Recycling of ODS

247. Ozone-depleting substances can be recovered, reclaimed and recycled:

(a) Recovery

Recovery means the collection and storage of ozone-depleting substances from machinery, equipment, containment vessels, and so forth, during servicing or prior to disposal.

(b) Recycling

Recycling means the reuse of a recovered ozone-depleting substance following a basic cleaning process such as filtering and drying.

(c) Reclamation

Reclamation means the reprocessing and upgrading of a recovered ozone-depleting substance through such methods as filtering, drying, distillation and chemical treatment in order to restore the substance to a specified standard of performance.

III.E.3.i. Destruction of ODS

248. Destruction of ODS refers to any process which, when applied to ozone-depleting substances, results in the permanent transformation or decomposition of all or a significant portion of such substances.

III.E.3.j. Sales of ODS

249. Ozone-depleting substances handed over to third parties - for purposes other than recovery, recycling, reclamation or destruction - shall be considered sales regardless of whether the underlying financial transaction has a negative or positive value for the reporting entity.

250. Sales of ODS shall be divided into the following four sub-categories:

  (a) ODS in manufactured goods;
  (b) ODS in traded goods;
  (c) ODS in containers;
  (d) ODS in equipment.

III.E.3.k. Emissions of ODS

251. An emission of an ozone-depleting substance occurs when the substance leaves the reporting entity during ordinary and extraordinary activities of an enterprise in such a way that it is technically impossible to regain control over the relevant ODS.

252. Emissions of ozone-depleting substances can be derived by calculating the total dependency on ODS and subtracting the amount recovered, reclaimed, recycled, destroyed, used as feedstock, sold and in stock, from it.

253. The item "emissions of ozone-depleting substances" can be used for the calculation of a secondary eco-efficiency indicator "emissions of ODS per net value added".

III.E.4. Recognition of Ozone-Depleting Substances

254. Ozone-depleting substances as defined in III.C.3 should be recognized in the period in which they are

  (a) Produced, purchased, reclaimed, recovered, recycled, reused, destroyed, sold or emitted; and
  (b) When it is probable that the amount or value can be measured.

255. Stocks of ozone-depleting substances as defined by III.C.3 should be recognized at the beginning and at the end of an accounting period.

256. A mixture containing ozone-depleting substances shall be recognized according to their respective components.[33]

[33] For information about the composition of mixtures, refer to the database reference tool known as the OAIC-DV MKV, circulated by UNEP Industry and Environment OzonAction Programme, or refer to the OzonAction website at http://www.unepie.org/ozonaction.html.

257. The ozone depletion potential of a substance shall be recognized according to the latest ozone depletion potential values listed in the Montreal Protocol.

III.E.5. Measurement of Ozone-Depleting Substances

258. Ozone-depleting substances should be weighed or metered.

259. Ozone-depleting substances should be measured in kilograms, metric tons, litres and cubic metres.

260. If an amount is estimated or calculated the range of uncertainty should be recorded.

261. Ozone-depleting substances shall be reported

(a) According to weight (kg, metric t) of the respective substance; and
(b) According to the respective ozone depletion potential (kg or metric t CFC-11 equivalent; see Box 5 in III.E.3.a).

III.E.6. Disclosure of Ozone-Depleting Substances

262. An enterprise should disclose:

(a) The eco-efficiency indicator "dependency on ODS per net value added";
(b) The accounting policies adopted for ozone-depleting substances;
(c) The total amount of ozone-depleting substances recognized during the accounting period and the respective amounts of the previous year.
(d) The total ozone depletion contribution as recognized during the accounting period and the respective amounts of the previous year.
(e) The management's stance on ozone-depleting substances and the Montreal Protocol, the objectives and targets regarding ozone-depleting substances and the measures taken to achieve the targets. The targets shall be compared with the targets set out in the Montreal Protocol. Special attention should be drawn to replacement technology and replacement substances and their respective environmental impact (e.g. global warming potential).

An example of a disclosure of ozone-depleting substances is given in the annex, III.F.

III.E.7. Annex to Ozone-Depleting Substances

III.E.7.a. Example of a Disclosure of Ozone-Depleting Substances

263. An ODS disclosure consists of three parts:

(a) Total dependency on ODS (Table 38), covering production, purchase and stocks;

(b) Total emissions of ODS (Table 39), covering recovery, reclamation, recycling, destruction, feedstock use, stocks and sales;

(c) Accounting policy on ODS, ODS policy, targets and measures (Table 40).

Table 38
Dependency on ODS

			Total (t substance)		**New ODS*** (t substance)		**Total ODC** (t CFC-11 eq.)	
Purpose and form	**Substance**	**ODP**	**2000**	**2001**	**2000**	**2001**	**2000**	**2001**
Production								
produced ODS	HCFC-21	0.04	1 000	500	10	50	40	20
Production of ODS			1 000	500	10	50	40	20
Purchase								
purchased ODS embodied in								
- supplied goods								
- supplied equipment	CFC-112	1	100				4	0
- traded goods								
purchased ODS for								
- goods manufactured								
- own production processes								
- own equipment	Halon-1301	10	2	1			0.08	0.04
- for trade								
Purchase of ODS			102	1	0	0	4.08	0.04
Stocks								
ODS in goods								
ODS as substance in containers			1	1				
ODS in equipment	halon-1301	10	1 200	1 300			48	52
ODS in use as process agent	HCFC-124	0.04	10	20			0.4	0.8
Stocks of ODS			1 211	1 321	0	0	48.44	52.84
Total dependency on ODS							**92.52**	**72.88**
Net value added (€)							10 000	11 000
Eco-efficiency indicator "dependency on ODS/value added" (t/€)							**0.925**	**0.663**

* The difference between the total amount and the amount listed as new ODS (virgin) is used ODS (recycled).

Table 39
Total Emissions of ODS

Purpose and form	Substance	ODP	Total (t substance) 2000	2001	Total ODC (t CFC-11 eq.) 2000	2001
Total dependency on ODS (from Table 38)					**92.52**	**72.88**
Recovered, reclaimed, recycled ODS						
Recovered						
Reclaimed						
Recycled	HCFC-124	0.04	1.012	2.12	0.04048	0.0848
Recovered, reclaimed, recycled ODS					*0.04048*	*0.0848*
Destruction of ODS and feedstock use						
feedstock use of ODS						
ODS destroyed	halon-1301	10	0.8	2.5	8	18
Destruction of ODS and feedstock use					*8*	*18*
Sales						
ODS in manufactured goods						
ODS in traded goods						
ODS as substance in containers						
ODS in equipment sold	halon-1301	10	1.5	0	15	0
Sales					*15*	*0*
Stocks of ODS (from Table 38)					*48.44*	*52.84*
Total ODS emissions (derived)					**21.04**	**1.96**
Net value added (€)					10 000	11 000
Secondary eco-efficiency indicator "emissions of ODS/value added" (kg/€)					**2.104**	**1.781**

Table 40
Accounting Policy on ODS, ODS Policy, Targets and Measures

Accounting policy on ODS	
ODS policy	
Targets	
Measures	

III.E.7.b. Controlled Substances and their Ozone Depletion Potential according to the Montreal Protocol

264. Table 41 lists controlled substances and their respective ozone-depleting potential according to the Montreal Protocol.[34]

265. Ozone-depleting potentials are expressed in kg CFC-11 ($CFCl_3$) equivalent per kg of the respective substance

266. Ozone-depleting potentials are based on existing knowledge and will be reviewed and updated periodically.

267. Where a range of ozone-depleting potentials is indicated, the highest value in that range shall be used for the purposes of this guideline.

268. The texts of the adjustments and amendments to the Protocol as agreed by the Parties to the Protocol are available at the Ozone Secretariat in UNEP or the Treaties Sections of the Ministries of Foreign Affairs of various Governments.

Table 41
Controlled Substances and their Ozone Depletion Potential
Montreal Protocol

Annex A	**(Montreal Protocol)**	
Group	**Substance**	**Ozone-Depleting Potential**
Group I		
$CFCl_3$	(CFC-11)	1.0
CF_2Cl_2	(CFC-12)	1.0
$C_2F_3Cl_3$	(CFC-113)	0.8
$C_2F_4Cl_2$	(CFC-114)	1.0
C_2F_5Cl	(CFC-115)	0.6
Group II		
CF_2BrCl	(halon-1211)	3.0
CF_3Br	(halon-1301)	10.0
$C_2F_4Br_2$	(halon-2402)	6.0

[34] As adjusted and/or amended in London (1990), Copenhagen (1992), Vienna (1995), Montreal (1997) and Beijing (1999).

Table 42
Controlled Substances and their Ozone Depletion Potential
London Amendment to the Montreal Protocol

Annex B	(London Amendment to the Montreal Protocol)	
Group	**Substance**	**Ozone-depleting potential**
Group I		
CF_3Cl	(CFC-13)	1.0
C_2FCl_5	(CFC-111)	1.0
$C_2F_2Cl_4$	(CFC-112)	1.0
C_3FCl_7	(CFC-211)	1.0
$C_3F_2Cl_6$	(CFC-212)	1.0
$C_3F_3Cl_5$	(CFC-213)	1.0
$C_3F_4Cl_4$	(CFC-214)	1.0
$C_3F_5Cl_3$	(CFC-215)	1.0
$C_3F_6Cl_2$	(CFC-216)	1.0
C_3F_7Cl	(CFC-217)	1.0
Group II		
CCl_4	Carbon tetrachloride	1.1
Group III		
$C_2H_3Cl_3$	1,1,1-trichloromethane[35] (methyl chloroform)	0.1

Table 43
Controlled Substances and their Ozone Depletion Potential
Copenhagen Amendment to the Montreal Protocol Part 1

Annex C	(Copenhagen Amendment to the Montreal Protocol)		
Group	**Substance**	**Number of isomers**	**Ozone-depleting potential**
Group I			
$CHFCl_2$	(HCFC-21)**	1	0.04
CHF_2Cl	(HCFC-22)**	1	0.055
CH_2FCl	(HCFC-31)	1	0.02
C_2HFCl_4	(HCFC-121)	2	0.01–0.04
$C_2HF_2Cl_3$	(HCFC-122)	3	0.02–0.08
$C_2HF_3Cl_2$	(HCFC-123)	3	0.02–0.06
$CHCl_2CF_3$	(HCFC-123)**	–	0.02
C_2HF_4Cl	(HCFC-124)	2	0.02–0.04
$CHFClCF_3$	(HCFC-124)**	–	0.022
$C_2H_2FCl_3$	(HCFC-131)	3	0.007–0.05
$C_2H_2F_2Cl_2$	(HCFC-132)	4	0.008–0.05
$C_2H_2F_3Cl$	(HCFC-133)	3	0.02–0.06
$C_2H_3FCl_2$	(HCFC-141)	3	0.005–0.07

[35] This formula does not refer to 1,1,2-trichloromethane.

** Identifies the most commercially viable substances with ODP values listed against them to be used for the purposes of the Protocol.

Table 44
Controlled Substances and their Ozone Depletion Potential
Copenhagen Amendment to the Montreal Protocol Part 2

Annex C	**(Copenhagen Amendment to the Montreal Protocol)**		
Group	**Substance**	**Number of isomers**	**Ozone-depleting potential**
Group I cont.			
CH_3CFCl_2	(HCFC-141b)**	–	0.11
$C_2H_3F_2Cl$	(HCFC-142)	3	0.008–0.07
CH_3CF_2Cl	(HCFC-142b)**	–	0.065
C_2H_4FCl	(HCFC-151)	2	0.003–0.005
C_3HFCl_6	(HCFC-221)	5	0.015–0.07
$C_3HF_2Cl_5$	(HCFC-222)	9	0.01–0.09
$C_3HF_3Cl_4$	(HCFC-223)	12	0.01–0.08
$C_3HF_4Cl_3$	(HCFC-224)	12	0.01–0.09
$C_3HF_5Cl_2$	(HCFC-225)	9	0.02–0.07
$CF_3CF_2CHCl_2$	(HCFC-225ca)**	–	0.025
CF_2ClCF_2CHClF	(HCFC-225cb)**	–	0.033
C_3HF_6Cl	(HCFC-226)	5	0.02–0.10
$C_3H_2FCl_5$	(HCFC-231)	9	0.05–0.09
$C_3H_2F_2Cl_4$	(HCFC-232)	16	0.008–0.10
$C_3H_2F_3Cl_3$	(HCFC-233)	18	0.007–0.23
$C_3H_2F_4Cl_2$	(HCFC-234)	16	0.01–0.28
$C_3H_2F_5Cl$	(HCFC-235)	9	0.03–0.52
$C_3H_3FCl_4$	(HCFC-241)	12	0.004–0.09
$C_3H_3F_2Cl_3$	(HCFC-242)	18	0.005–0.13
$C_3H_3F_3Cl_2$	(HCFC-243)	18	0.007–0.12
$C_3H_3F_4Cl$	(HCFC-244)	12	0.009–0.14
$C_3H_4FCl_3$	(HCFC-251)	12	0.001–0.01
$C_3H_4F_2Cl_2$	(HCFC-252)	16	0.005–0.04
$C_3H_4F_3Cl$	(HCFC-253)	12	0.003–0.03
$C_3H_5FCl_2$	(HCFC-261)	9	0.002–0.02
$C_3H_5F_2Cl$	(HCFC-262)	9	0.002–0.02
C_3H_6FCl	(HCFC-271)	5	0.001–0.03
Group II	Note: HBFCs (hydrobromofluorocarbons) have already been phased out by all Parties. Therefore, we do not list them in this guideline. Consult the Copenhagen Amendment to the Montreal Protocol for the original list.		
Group III			
CH_2BrCl	Bromochloromethane	1	0.12

Annex E		
Group	**Substance**	**Ozone-depleting potential**
Group I		
CH_3Br	Methyl bromide	0.6

III.E.7.c. Products Containing Ozone-Depleting Substances

269. Table 45 lists products which contain ozone-depleting substances as specified in Annex A of the Protocol.

Table 45
A list of products containing controlled substances specified in Annex A of the Protocol

Products
Automobile and truck air conditioning units (whether incorporated in vehicles or not)
Domestic and commercial refrigeration and air conditioning/heat pump equipment, e.g.: • Refrigerators • Freezers • Dehumidifiers • Water coolers • Ice machines • Air conditioning and heat pump units
Aerosol products
Portable fire extinguishers
Insulation boards, panels and pipe covers
Pre-polymers

Source: UNEP (1999).

III.E.7.d. Main Sectors using Ozone-Depleting Substances

270. Table 46 lists products which contain controlled substances as specified in Annex A of the Protocol.

Table 46
Main Sectors Using Ozone-Depleting Substances

Sector	Sub-sector	Substance mainly used
Aerosols and sterilants		CFCs 11, 12, 113, 114
Foams	Polyurmethane foam, phenolic foams, polyolefin foams, extruded polystyrene (in particular for various kinds of insulation, packaging, cushions/bedding)	CFCs 11, 12, 113, 114; HCFCs 22, 123, 124, 141b, 142b
Fire fighting	Fire extinguishing	Halons 1211, 1301, 2402; HCFCs 22, 123, 124
Refrigeration	Domestic, commercial, industrial, transport refrigeration; food processing and storage; heat pumps; air conditioning	CFCs 12, 11, 113, 114, 115; HCFCs 22, 123, 124, 142b; other fully halogenated CFCs (CFC 13, 112)
Solvent	Electronics; precision cleaning, metal applications cleaning, dry cleaning; coatings and inks; aerosols	CFC-113, Methyl Chloroform (1,1,1-trichloromethane), Carbon Tetrachloride, HCFCs 225, 225ca, 225cb, 123, 141b
Fumigation etc.	Fumigation of soil, durables, perishables, and structures and transportation	Methyl Bromide
Other	e.g. tobacco fluffing	CFC-11

Note: The following substances are not included in the list: B I substances (other fully halogenated CFCs) are rarely used and C II substances (HBFCs) are not used. Source: UNEP (1999).

III.F. Accounting Treatment of Waste

III.F.1. Objective

271. The objective of this manual is to provide guidance regarding the accounting treatment of waste.

III.F.2. Scope

272. This guidance should be applied by all enterprises in accounting for all types of waste generated by them as defined in III.F.3.

III.F.3. Definitions

III.F.3.a. General Definition of Waste

273. Waste is defined as a non-product output with a negative or zero market value. Waste can be solid, liquid or have a paste-like consistency. Water and air-polluting emissions – although they are non-product output – are not regarded as waste.

274. If the value of the waste fluctuates according to market conditions, accumulated net costs/revenues during the reporting period are used to determine the market value.

III.F.3.b. Definitions Based on the Quality of Waste

275. Waste is divided into the following sub-categories according to its quality:

(a) Mineral

Waste that is categorized as mineral or mineralized is inert (see Box 7), essentially insoluble and not decomposable.[36] Mineral quality waste is safe by nature. It can be discharged without requiring special landfill technology and/or long-term landfill management.

(b) Non-mineral

Waste that is categorized as non-mineral has the potential to be chemically and/or biologically reactive, is soluble and/or decomposable.[37] Discharge requires special landfill technology and/or long-term landfill management. Non-mineral waste can be mineralized through waste treatment technology.

36 Examples of mineral waste include rock, brick and glass. Mineralized waste is non-mineral waste treated in a manner that the result is of mineral quality; for example all carbon is oxidized through an incineration process.

37 Examples include household waste, agricultural waste and most industrial waste. All waste containing carbon that can be oxidized is non-mineral waste.

Box 7. Inert material[38]

Waste is deemed to be inert if chemical analysis reveals the following:

- A high percentage of waste by weight (e.g. 95 per cent) relative to the dry substance consists of material similar to stone such as silicates, carbonates or aluminates;
- The concentration of heavy metals is limited;
- When a crushed sample of waste is extracted with distilled water no more than a certain limit of waste per kg of dry substance is dissolved.

Defined limits of different substances are not exceeded in the eluate[39] of the waste.

276. If no specific information is available on the quality of the waste it is assumed to be non-mineral.

III.F.3.c. Definitions Based on the Classification of Waste

277. Waste is further classified according to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (Basel Convention).

278. Waste is classified as hazardous when one or more of the following conditions are met:

(a) Waste belonging to any category contained in Annex I of the Basel Convention (see III.F.7.a) and possessing any of the characteristics contained in Annex III of the Basel Convention;
(b) Waste that possesses any of the characteristics contained in Annex III of the Basel Convention;
(c) Waste which, as a result of being radioactive, is subject to other national or international control systems;
(d) Waste that is not covered under paragraphs (a) and (b) but is defined as, or considered to be, hazardous waste by the domestic legislation in the country where the waste is generated by the reporting enterprise.

279. Wastes which are not covered by any of the above paragraphs (a), (b), (c) or (d) shall be regarded as "other waste".

[38] Based on the definition by the Swiss Agency for the Environment, Forest and Landscape, Technical Ordinance on Waste, 1996

[39] Elution is the process of removing one substance from another, usually an absorbed material from an absorbent material, by washing it out with a solvent. The eluate is the liquid left after the process of elution, consisting of dissolved matter and the solvent used.

III.F.3.d. Definitions Referring to Waste Treatment Technology

280. Waste treatment technologies are processes applied to waste to permanently alter their condition through chemical, biological or physical means, and intend to reduce or eliminate their danger to people and the environment.

281. Treatment of waste means recovery of waste, which renders it harmless, for final disposal.

282. Waste treatment includes temporary storage but not collection and transportation of waste. Waste is considered temporarily stored when it will later undergo a waste treatment process.

283. Waste treatment technology is divided into the following sub-categories:

(a) Reuse, re-manufacturing, recycling

(i) Reuse is the additional use of a component, part or product after it has been removed from a clearly defined service cycle. Reuse does not include a manufacturing process, however, cleaning, repair or refurbishing may be done between uses.

(ii) Re-manufacturing is the additional use of a component, part, or product after it has been removed from a clearly defined service cycle in a new manufacturing process that goes beyond cleaning, repair or refurbishing.

(iii) Recycling is recovery and reuse of materials from scrap or other waste materials for the production of new goods. Energy recovery (called "thermal recycling") is not regarded as recycling but as incineration. Pre-treatment processes that condition the waste for recycling are regarded as part of the recycling path.

For the purpose of eco-efficiency, reporting companies shall further distinguish between open- and closed-loop reuse, re-manufacturing and recycling.

(iv) Open-loop

The recycled, reused or re-manufactured material is not returned to the processes of the reporting entity; instead, it is returned to the market.

(v) Closed-loop

The recycled, reused or remanufactured material is returned to the processes of the reporting entity. In-process recycling is the shortest possible closed-loop.

(b) Waste incineration

Incineration of waste, mineralizes it and reduces the volume of solid residuals. It results in the output of "other" waste streams, that is air emissions, ash, slag, heat etc., that are supposed to be treated adequately (for treatment schemes that convert waste to energy see Box 8). Types of controlled incineration processes include:

(i) Low-temperature (municipal) waste incinerators;
(ii) High-temperature waste incinerators;
(iii) Cement kilns.

Box 8. Waste to Energy Schemes

Waste can be directly combusted in waste-to-energy incinerators or it can be processed as refuse-derived fuel before incineration (or combustion e.g. in power plants), and it can be gasified using pyrolysis or thermal gasification techniques. Another waste-to-energy process is the recovery of landfill gas or the gas produced by anaerobic fermentation (digestion) of municipal sewage sludge.

For the purpose of this guideline we suggest that incineration not be distinguished by the type of energy recovery scheme attached to the incineration process but rather that incineration schemes be distinguished by the technology used to mineralize waste. The fact that energy is recovered should be disclosed.

(c) Sanitary landfill

Sanitary landfills provide outlets for the ultimate disposal of waste generated. A sanitary landfill is a controlled area of land on which waste is disposed of, in accordance with standards, rules or orders established by a regulatory body. Waste material is placed in trenches or on land, compacted by mechanical equipment and covered with earth and a final cover.

Within the category of sanitary landfill three technologies can be distinguished:

(i) Bioactive sanitary landfills

The material is of non-mineral quality (see III.F.3.b). It is reactive and therefore needs extensive control systems covering the operational, closure and post-closure phase.[40] The chemical composition of the residues is not known.

(ii) Sanitary landfills for stabilized residues

Similar to (i) but for materials that will not form either gases or water soluble substances when in contact with water, air or other stabilized residues. The chemical composition of the residues is well known.

(iii) Sanitary landfills for inert materials

The material is inert (mineral quality, see III.F.3.b). Therefore the landfill needs no control systems during the operation phase, closure and post-closure phase.

40 For example, ground water is monitored, corrective action requirements are in place, closure and post-closure criteria are defined, an operation and maintenance manual and a leachate management plan exists, and so on.

(d) Open dumpsite

An open dumpsite is an uncontrolled area of land on which waste is disposed, either legally or illegally.

(e) Special cases: Pre-treatment and temporary on-site storage of waste

(i) Pre-treatment

Pre-treatment processes prepare waste for incineration or landfill. For the purpose of this guideline, pre-treatment does not constitute a separate category of waste treatment technology. Waste that undergoes external pre-treatment is dealt with under waste incineration and landfill. If the path is not known and documented, landfill is assumed.

(ii) Temporary on-site storage

Waste that is temporary stored on-site and for which the treatment technology is not yet known constitutes a separate category of waste treatment technology. The reporting entity shall give special attention to include adequate information on the technology used and the processes involved in the on-site storage.

284. If no company-specific information on the treatment technology is available, landfill is assumed as the default treatment technology.

285. Companies shall disclose information on the quality of treatment technology applied to waste. The classification should at least cover the following categories (world-wide or country specific):

(a) Best available technology;
(b) Average technology;
(c) Worst available technology.

286. If no information is disclosed on the type of technology used it is assumed to be the worst available technology.

III.F.3.e. Definitions Referring to the Location of Waste Treatment

287. On-site refers to all processes and activities that take place on premises under the control of the reporting entity.

288. Off-site refers to all processes and activities that take place on premises out of the control of the reporting entity.

289. Control is the power to govern the financial and operating policies of an enterprise so as to obtain benefits from its activities (IAS 27, paragraph 6).

III.F.3.f. Definitions Referring to Waste Generated

290. Total waste generated during a reporting period is defined as the total amount of all mineral, non-mineral and/or hazardous waste as defined by

III.F.3.c and treated by any waste treatment technology as defined by III.F.3.d This excludes the amount that is treated either on-site or off-site (see III.F.3.e) through closed-loop recycling, reuse or remanufacturing processes (see paragraph 283(a)(v)).

291. The item "waste generated" is used for the calculation of the eco-efficiency indicator "waste generated per unit of value added" (see paragraph 76(e)).

III.F.4. Recognition of Waste

292. Waste as defined by III.F.3.a should be recognized in the period in which it is generated. If generated waste is temporarily stored on-site the stockpile should be recognized at the beginning and the end of the reporting period.

293. The quality of waste as defined by III.F.3.b should be recognized in the period in which it is generated.

294. The class of waste as defined by III.F.3.c should be recognized prior to being treated.

295. Waste treatment technology as defined by III.F.3.d should be recognized when the waste is treated (on-site treatment) and/or when it gets out of the control of the reporting enterprise (off-site treatment).

III.F.5. Measurement of Waste

296. Waste should be weighed or metered.

297. Waste should be measured in kilograms and metric tons, litres or cubic metres.

298. If an amount of waste is estimated or calculated the range of uncertainty should be recorded.

299. Waste shall be reported according to weight (kg, t) and not volume (litres, m3).

III.F.6. Disclosure of Waste

300. An enterprise should disclose:

   (a) The eco-efficiency indicator "waste generated per unit of net value added";
   (b) The accounting policies adopted on waste;
   (c) Total amount of waste recognized during the accounting period and the respective amounts of the previous year;
   (d) The quality of the waste as recognized;
   (e) The classification of the waste as recognized;

(f) The treatment technology as recognized;

(g) Energy recovery in waste-to-energy schemes;

(h) The management's stance on waste management policy, the objectives and targets regarding waste and the measures taken to achieve the targets.

An example of a disclosure of waste is given in the annex, III.G.

III.F.7. Annex to Waste

III.F.7.a. Example of Disclosure of Waste

301. A disclosure on waste generated consists of three parts:

(a) Total waste generated according to the quality and classification of the waste and the treatment technology applied;

(b) Accounting policy on waste, waste policy, targets and measures (Table 48).

Table 47
Waste Generated

Waste generated	**Quality and classification**							
Treatment technology	**Mineral**		**Non-mineral**				**Total***	
	Non-hazardous				**Hazardous**			
	2000	**2001**	**2000**	**2001**	**2000**	**2001**	**2000**	**2001**
Open-loop reuse, remanufacturing, recycling	**83.8**	**23.8**	**105.7**	**74.0**	**38.0**	**2.1**	**189.5**	**97.8**
• *Reuse*	*58.6*	*10.8*	*15.2*	*21.5*	*1.1*	*0.0*	*73.8*	*32.4*
• *Remanufacturing*	*8.3*	*5.4*	*8.4*	*8.1*	*0.6*	*1.1*	*16.7*	*13.6*
• *Recycling*	*16.8*	*7.5*	*82.2*	*44.4*	*36.3*	*1.0*	*99*	*51.9*
Incineration	**87.4**	**52.4**	**45.4**	**74.5**	**12.2**	**26.7**	**132.8**	**126.9**
• *Low-temperature*	*9.2*	*12.2*	*7.3*	*14.3*	*5.7*	*10.3*	*16.5*	*26.4*
• *High-temperature*	*75.3*	*9.9*	*19.0*	*18.6*	*5.2*	*9.6*	*94.3*	*28.5*
• *Cement kilns*	*3.0*	*30.3*	*19.1*	*41.6*	*1.3*	*6.9*	*22.1*	*71.9*
Sanitary landfills	**78.2**	**104.5**	**130.4**	**21.2**	**55.6**	**34.7**	**208.6**	**125.7**
• *Landfills for bioactive materials*	*35.8*	*10.3*	*22.5*	*10.4*	*12.8*	*33.3*	*58.3*	*20.7*
• *Landfills for stabilized materials*	*39.3*	*21.9*	*51.1*	*3.0*	*3.8*	*0.9*	*90.4*	*24.8*
• *Landfills for inert materials*	*3.1*	*72.3*	*56.9*	*7.9*	*39.0*	*0.5*	*60*	*80.2*
Open dumpsite	**67.0**	**0.2**	**12.3**	**5.4**	**0.4**	**5.2**	**79.3**	**5.6**
Temporary stored on-site°	**14.6**	**42.0**	**46.8**	**55.2**	**1.4**	**0.3**	**61.3**	**97.3**
Total	**331.0**	**222.9**	**340.6**	**230.4**	**107.5**	**68.9**	**671.6**	**453.3**
Closed-loop reuse, remanufacturing, recycling	**-10.0**	**-12.0**	**-5.2**	**-3.0**	**-0.1**	**-0.2**	**-15.2**	**-15.0**
• *Reuse*	*-10.0*	*-12.0*	*-2.1*	*-2.0*	*-0.1*	*-0.2*	*-12.1*	*-14.0*
• *Remanufacturing*			*-1.5*	*-1.0*		*0.0*	*-1.5*	*-1.0*
• *Recycling*			*-1.6*	*0.0*		*0.0*	*-1.6*	
Total waste generated	**321.0**	**210.9**	**335.4**	**227.4**	**107.4**	**68.7**	**656.4**	**438.3**
Net value added (€)							1 000	1 100
Eco-efficiency indicator "waste generated/net value added" (m^3/€)							**0.656**	**0.438**

Notes: **The columns "non-mineral" and "mineral" add up to 100%, while the column "hazardous" lists that amount of non-mineral waste that is classified as hazardous.*
°To store waste temporary on-site best technologies are used.

Table 48
Accounting Policy on Waste, Waste Policy, Targets and Measures

Accounting policy	
Waste policy	
Targets	
Measures	

III.F.7.b. Annex I of the Basel Convention

302. Under the Basel Convention (Annex I, categories Y1-45) the categories of waste in Table 49 have to be controlled.

Table 49
Annex I of the Basel Convention
Categories of Waste to be Controlled Y1-Y29

Category	Definition
Y1	Clinical wastes from medical care in hospitals, medical centres and clinics
Y2	Wastes from the production and preparation of pharmaceutical products
Y3	Waste pharmaceuticals, drugs and medicines
Y4	Wastes from the production, formulation and use of biocides and phytopharmaceuticals
Y5	Wastes from the manufacture, formulation and use of wood preserving chemicals
Y6	Wastes from the production, formulation and use of organic solvents
Y7	Wastes from heat treatment and tempering operations containing cyanides
Y8	Waste mineral oils unfit for their originally intended use
Y9	Waste oils/water, hydrocarbons/water mixtures, emulsions
Y10	Waste substances and articles containing or contaminated with polychlorinated biphenyls (PCBs) and/or polychlorinated terphenyls (PCTs) and/or polybrominated biphenyls (PBBs)
Y11	Waste tarry residues arising from refining, distillation and any pyrolytic treatment
Y12	Wastes from production, formulation and use of inks, dyes, pigments, paints, lacquers, varnish
Y13	Wastes from production, formulation and use of resins, latex, plasticizers, glues/adhesives
Y14	Waste chemical substances arising from research and development or teaching activities which are not identified and/or are new and whose effects on man and/or the environment are not known
Y15	Wastes of an explosive nature not subject to other legislation
Y16	Wastes from production, formulation and use of photographic chemicals and processing materials
Y17	Wastes resulting from surface treatment of metals and plastics
Y18	Residues arising from industrial waste disposal operations
Y19	Metal carbonyls
Y20	Beryllium; beryllium compounds
Y21	Hexavalent chromium compounds
Y22	Copper compounds
Y23	Zinc compounds
Y24	Arsenic; arsenic compounds
Y25	Selenium, selenium compounds
Y26	Cadmium; cadmium compounds
Y27	Antimony; antimony compounds
Y28	Tellurium; tellurium compounds
Y29	Mercury; mercury compounds

Table 50
Annex I of the Basel Convention
Categories of Waste to be Controlled Y30-Y45

Category	Definition
Y30	Thallium; thallium compounds
Y31	Lead, lead compounds
Y32	Inorganic fluorine compounds excluding calcium fluoride
Y33	Inorganic cyanides
Y34	Acidic solutions or acids in solid form
Y35	Basic solutions or bases in solid form
Y36	Asbestos (dust and fibres)
Y37	Organic phosphorous compounds
Y38	Organic cyanides
Y39	Phenols; phenol compounds including chlorophenols
Y40	Ethers
Y41	Halogenated organic solvents
Y42	Organic solvents excluding halogenated solvents
Y43	Any congenor of polychlorinated dibenzo-furan
Y44	Any congenor of polychlorinated dibenzo-p-dioxin
Y45	Organohalogen compounds other than substances referred to in this Annex (e.g. Y39, Y41, Y42, Y43, Y44).

III.F.7.c. Annex III of the Basel Convention

303. According to the Basel Convention (Annex III, categories H1-H13) hazardous waste possesses the characteristics listed in Table 51 and Table 52.

Table 51
Annex III of the Basel Convention List of Hazardous Characteristics
Class 1-4.3

UN Class1[41]	Code	Characteristics
1	H1	***Explosive*** An explosive substance or waste is a solid or liquid substance or waste (or mixture of substances or wastes) which is in itself capable by chemical reaction of producing gas at such a temperature and pressure and at such speed as to cause damage to the surroundings.
3	H3	***Flammable liquids*** The word "flammable" has the same meaning as "inflammable." Flammable liquids are liquids, or mixtures of liquids, or liquids containing solids in solution or suspension (for example, paints, varnishes, lacquers, etc., but not including substances or wastes otherwise classified on account of their dangerous characteristics) which give off a flammable vapour at temperatures of not more than 60.5E C, closed-cup test, or not more than 65.6EC, open-cup test. (Since the results of open-cup tests and of closed-cup tests are not strictly comparable and even individual results by the same test are often variable, regulations varying from the above figures to make allowance for such differences would be within the spirit of this definition.)
4.1	H4.1	***Flammable solids*** Solids, or waste solids, other than those classed as explosives, which under conditions encountered in transport are readily combustible, or may cause or contribute to fire through friction.
4.2	H4.2	***Substances or wastes liable to spontaneous combustion*** Substances or wastes which are liable to spontaneous heating under normal conditions encountered in transport, or to heating up on contact with air, and being then liable to catch fire.
4.3	H4.3	***Substances or wastes which, in contact with water, emit flammable gases*** Substances or wastes which, by interaction with water, are liable to become spontaneously flammable or to give off flammable gases in dangerous quantities.

[41] Corresponds to the hazard classification system included in the United Nations Recommendations on the Transport of Dangerous Goods (ST/SG/AC.10/1Rev.5, United Nations, New York, 1988).

Table 52
Annex III of the Basel Convention List of Hazardous Characteristics
Class 5.1-9

UN Class1	Code	Characteristics (cont.)
5.1	H5.1	***Oxidising*** Substances or wastes which, while in themselves not necessarily combustible, may, generally by yielding oxygen, cause, or contribute to, the combustion of other materials.
5.2	H5.2	***Organic Peroxides*** Organic substances or wastes which contain the bivalent-OO-structure are thermally unstable substances which may undergo exothermic self-accelerating decomposition.
6.1	H6.1	***Poisonous (Acute)*** Substances or wastes liable either to cause death or serious injury or to harm health if swallowed or inhaled or by skin contact.
6.2	H6.2	***Infectious substances*** Substances or wastes containing viable micro-organisms or their toxins which are known or suspected to cause disease in animals or humans.
8	H8	***Corrosives*** Substances or wastes which, by chemical action, will cause severe damage when in contact with living tissue, or, in the case of leakage, will materially damage, or even destroy, other goods or the means of transport; they may also cause other hazards.
9	H10	***Liberation of toxic gases in contact with air or water*** Substances or wastes which, by interaction with air or water, are liable to give off toxic gases in dangerous quantities.
9	H11	***Toxic (Delayed or chronic)*** Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity.
9	H12	***Ecotoxic*** Substances or wastes which if released present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.
9	H13	Capable, by any means, after disposal, of yielding another material, e.g., leachate, which possesses any of the characteristics listed above.

Tests

The potential hazards posed by certain types of wastes are not yet fully documented; tests to define quantitatively these hazards do not exist. Further research is necessary in order to develop means to characterise potential hazards posed to man and/or the environment by these wastes. Standardised tests have been derived with respect to pure substances and materials. Many countries have developed national tests, which can be applied to materials listed in Annex I, in order to decide if these materials exhibit any of the characteristics listed in this Annex.

III.G. Accounting Treatment of the Financial Items

III.G.1. Objective

304. The objective of this manual is to provide guidance on the accounting treatment of the financial items used as reference figures for normalization in eco-efficiency accounting and reporting.

III.G.2. Scope

305. This guidance should be applied by all enterprises in accounting for all reference figures used as normalization values for eco-efficiency indicators.

III.G.3. Definitions

306. All financial items are defined in line with the International Accounting Standards (IAS).

307. For the purpose of eco-efficiency accounting and reporting, the following items are of importance and are defined as follows:

(a) Value Added (see Box 9)
Value Added = Revenue – Purchase of Goods and Services

(b) Net Value Added = Value Added - Depreciation on tangible assets

(c) Revenue is defined as the gross inflow of economic benefits during a period arising in the course of the ordinary activities of an enterprise when those inflows result in an increase in equity, excluding increases relating to contributions from equity participants (see IAS 18). Revenue includes only gross inflows of economic benefits received and receivable by the enterprise on its own account. It does not include taxes collected on behalf of third parties, nor does it include the amounts collected on behalf of the principle as in an agency relation. Revenue is generated from the following transactions as defined by IAS 18:
   (i) Sales of goods;
   (ii) Rendering of services;
   (iii) Interest, royalties and dividends

(d) Purchase of goods and services is the gross outflow of economic benefit to the supplier of the goods and services during a period arising in the course of the ordinary activities of an enterprise when those outflows would qualify as revenue according to IAS 18 with the supplier.

Box 9. Value Added/Net Value Added

Value added is a widely used but often poorly understood concept in accounting. It is widely used in the sense that value added is the aggregate that gets taxed by a value added tax scheme. A value added tax is levied on the value which is added to the goods or services in question at each stage in the production and distribution process. This is achieved by levying a tax at each point en route, as ownership passes from one person to another. At every stage, "output" tax is charged on the current sales value, but the "input" tax which has been charged by those at an earlier stage of the game can be offset or recovered. Thus the tax liability at each stage is based on the difference between the value of the outputs and the value of the inputs (hence "added value"). Most countries have implemented a VAT.

For social reporting it is used to show how the value created is distributed amongst different stakeholders (employees, lenders, authorities, shareholders). Value added is used as a normalization figure in environmental reports especially with multi-product companies, where for example tonnes of production is meaningless.

There are two alternative ways to calculate value added, one method asks how value added is generated (source or tax approach), while the other asks how value added is distributed (distribution approach):

- Source or tax approach:
  Value added = Revenue – Cost of goods and services purchased
- Distribution approach:
  Value added = Salaries + Depreciation + Amortisation + Interest Paid + Taxes + Dividends + Retained Profit

Both approaches yield the same answer.[42]

For the purpose of eco-efficiency accounting we need to go one step further (Lahti-Nuuttila 2002). Investment goods are not accounted for as goods and services purchased but rather as depreciation, although both are purchased from outside the enterprise. For the purpose of eco-efficiency accounting, investment goods (tangible assets to be precise) and goods purchased should not be treated differently. Their value has been created outside the enterprise and the energy, water etc. used and the waste produced for the production of the asset are accounted for within the accounts of the enterprise that produced the respective asset. Therefore, depreciation on tangible assets is deducted from value added. The resulting figure is defined as follows:

Net value added = Revenue – Cost of goods and services purchased – Depreciation on *tangible* assets

Net value added = Salaries + Amortization on *intangible* assets + Interest paid + Taxes + Dividends + Retained Profit

[42] On the assumption that tangible assets are purchased from outside the enterprise. In turn, only amortisation of intangible assets is included in value added under the distribution approach.

III.G.4. Recognition

308. The financial items shall be recognized according to applicable IAS standards.

III.G.5. Measurement

309. The financial items shall be measured according to applicable IAS standards.

III.G.6. Disclosure

310. The financial items shall be disclosed according to applicable IAS standards.

III.H. Consolidation of Eco-efficiency Indicators

III.H.1. Primary Issues in Consolidating Environmental Items

311. The primary issues in consolidating environmental items are:

(a) The scope of consolidation

The scope of consolidation indicates which enterprises are and which are not integrated into the consolidated figures.

(b) The method of consolidation

For a useful analysis of consolidated data, the methods of consolidation must be known and it must be clear that all entities consolidated have applied uniform accounting policies for like transactions and other events in similar circumstances.

312. The scope and the methods of consolidation applied can influence the consolidated financial and environmental figures materially. According to the consolidation method applied, certain data may or may not appear in the consolidated group accounts.

III.H.2. Objective

313. The objective of this manual is to provide guidance on the accounting treatment for eco-efficiency indicators and their environmental and financial items respectively, for a parent and its subsidiaries, its investments in associates and/or joint ventures.

III.H.3. Definition

314. The following terms are used in this guideline with the meanings specified:

(a) A subsidiary is an enterprise that is controlled by another enterprise (known as a parent) (IAS 27, paragraph 6).

(i) A parent is an enterprise that has one or more subsidiaries (IAS 27, paragraph 6);

(ii) A group is a parent and all its subsidiaries (IAS 27, paragraph 6);

(iii) Control is the power to govern the financial and operating policies of an enterprise so as to obtain benefits from its activities (IAS 27, paragraph 6). Control is presumed to exist when the parent owns, directly or indirectly through subsidiaries, more than half of the voting power of an enterprise (IAS 27, paragraph 12).

(b) An associate is an enterprise in which the investor has significant influence and which is neither a subsidiary nor a joint venture of the investor (IAS 28, paragraph 3).

(c) A joint venture is a contractual arrangement whereby two or more parties undertake an economic activity, which is subject to joint control (IAS 31, paragraph 2).

(d) Consolidated eco-efficiency information is the eco-efficiency data of a parent and its subsidiaries, its interests in associates and joint ventures presented as those of a single enterprise.

III.H.4. Scope of Guidance

315. This guidance should be applied by all enterprises in the preparation and presentation of consolidated eco-efficiency data for subsidiaries (IAS 27), investments in associates (IAS 28) and investments in joint ventures (IAS 31).

316. Accounting policies for consolidation as defined by IAS 27, 28, 31 and other standards apply accordingly.

III.H.5. Consolidation Procedure

317. Consolidated eco-efficiency statements should be prepared using uniform accounting policies for both the environmental and the financial items for like transactions and other events in similar circumstances (IAS 27, paragraph 21).

318. The starting point for the recognition and measurement of eco-efficiency information - regardless of whether it is environmental or financial - are activities and events of the reporting entity. When recognizing environmental information, an enterprise shall look at the same set of activities and events as when recognizing the financial information (see II.E.1 of the framework on the principle of congruity). This implies that uniform accounting policies must be applied when consolidating financial and environmental items (see paragraph above).

319. Therefore the consolidation method used for the consolidated financial report (equity, full, proportional consolidation; for a description of these methods see I.A.1) shall also be applied to the consolidation of the environmental items used for the eco-efficiency indicators. If the financial items or group of financial items used for a consolidated eco-efficiency statement (net value added, revenue, purchase of goods and services) are

(a) Fully consolidated, then the environmental items shall also be fully consolidated;
(b) Consolidated using the equity method, then the environmental items shall also be consolidated on the basis of equity consolidation;
(c) Proportionally consolidated then the environmental items shall also be proportionally consolidated.

320. The implications are as follows:

(a) The consolidated eco-efficiency data fully include the environmental and financial items of subsidiaries that are controlled by the parent.
(b) In the case of associates where equity consolidation is applied the consolidated eco-efficiency data do not include environmental and financial items of the associates.

(c) In the case of joint ventures where proportionate consolidation is applied the consolidated eco-efficiency data include environmental and financial items of the joint venture. In that case, environmental and financial items of the joint venture are included in the consolidated eco-efficiency data in line with the percentage used in financial consolidation.

III.H.6. Disclosure

321. In a consolidated eco-efficiency statement an enterprise should disclose a listing of all subsidiaries, investments in associates and joint ventures including

(a) The names and descriptions of all subsidiaries, investments in associates and joint ventures;
(b) The magnitude of control (e.g. the percentage of voting share);
(c) The consolidation method used in the financial statements;
(d) The eco-efficiency information of all consolidated entities, regardless of whether they are consolidated fully, proportionately, or by using the equity method;
(e) A management discussion on the financial and environmental aspects of the consolidation methodology and procedure applied;
(f) A management discussion on the financial and environmental aspects of mergers, acquisitions or divesting activities in the reporting period.

III.H.7. Annex to Consolidation

322. IAS and other standards require three different methods of consolidation depending on the stake of the investor: full consolidation, equity consolidation or proportional consolidation. The standard procedures are (IAS 22,27,31):

III.H.7.a. Full Consolidation

323. Under full consolidation, the financial statements of the enterprises in the group are combined on a line-by-line basis by adding together like items of assets, liabilities, equity, income and expenses. Inter-enterprise balances and inter-enterprise transactions are totally eliminated. Any unrealized profits resulting from inter-enterprise transactions are eliminated, and any unrealized losses would also be eliminated unless costs cannot be recovered. The carrying amounts of any inter-enterprise investments (in particular, those of the parent enterprise) and the related portion of the equity of each of the group enterprises are eliminated.

324. Full consolidation is normally applied to all enterprises that are controlled by a parent enterprise. This means that, in practice, the parent enterprise owns or controls, directly or indirectly, 50 per cent or more of voting rights. The enterprise under the parent's control is referred to as a subsidiary.

III.H.7.b. Equity Method

325. Under the equity method, the investor's investment in an investee enterprise is initially recorded at cost and is adjusted thereafter for changes in the net assets of that enterprise (IAS 28, paragraph 3). As is the case in full consolidation, inter-enterprise balances and inter-enterprise transactions are eliminated, together with any unrealized profits and losses relating thereto.

326. The equity method is normally applied for investments in "associates". An "associate" is an enterprise which is neither a subsidiary nor a joint venture and in which the investor has a significant influence (normally, between 20 per cent and 49 per cent). Standards issued by the IASB indicate that "an investment in an associate should be accounted for in consolidated financial statements under the equity method except when the investment is acquired and held exclusively with a view to its disposal in the near future in which case it should be accounted for under the cost method"[43] (IAS 28, paragraph 8). "Significant influence" is described by the IASB as the power to participate in the financial and operating policy decisions of the investee but not control over those policies (IAS 28, paragraph 3).

327. The Intergovernmental Working Group of Experts on International Standards of Accounting and Reporting (ISAR) has indicated that "under the equity method, an initial investment by a transnational corporation in another enterprise is so adjusted in the consolidated financial statements of the transnational corporation as to reflect its share of the net assets of the other enterprise. The consolidated income statements reflect the transnational corporation's share of the operating results of the other enterprise" (UNCTAD 1994, paragraph 50).

III.H.7.c. Proportionate Consolidation

328. Under proportionate consolidation, the parent's/investor's share of each of the assets, liabilities, income and expenses of the other group's enterprises is combined on a line-by-line basis with similar items in the parent's/investor's financial statements. Again, inter-enterprise balances and inter-enterprise transactions are eliminated, together with any unrealized profits and losses relating thereto.

329. Proportionate consolidation is normally only used in accounting for the interests in a joint venture (which has been defined by the IASB as "a contractual arrangement whereby two or more parties undertake an economic activity so as to obtain benefits from it" (IAS 31, paragraph 2). Even in this situation, the method is not permitted in some jurisdictions.

[43] Under the cost method, the investment is recorded at its initial cost. The income statement reflects income from the investment only to the extent that the investor receives a share of the accumulated net profits of the investee, arising after the investment has been made.

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