



ENVIRONMENTAL AND SUSTAINABILITY GUIDELINES

27 September 2017

NEFCO ENVIRONMENTAL AND SUSTAINABILITY GUIDELINES¹

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NEFCO 12.9.2017 Anja Nystén / Husamuddin Ahmadzai

¹ These Environmental and Sustainability Guidelines adopted by the Board of Directors of NEFCO on 27 September 2017 replace the Environmental Guidelines and Methodology of March 2008.

Abbreviations

CO ₂	Carbon Dioxide
CO _{2e}	Carbon Dioxide equivalent
EA	Environmental Audit
EbA	Eco-based Adaptation
EIA	Environmental Impact Assessment
EnA	Energy Audit
EP	Environmental and Sustainability Procedures
EPE	European Principles for the Environment
ER	Environmental and Energy Review
ESR	Environmental Status Report
EU	European Union
IFI	International Financial Institution
NEFCO	Nordic Environment Finance Corporation
OECD	The Organisation for Economic Co-operation and Development
PCR	Project Completion Report
pER	Preliminary Environmental and Energy Review
SDG	Sustainable Development Goal
UAC	Unit Abatement Cost
VOC	Volatile Organic Compound

Main Definitions²

Term	Definition
Adaptation	Adaptation refers to changes in an organism's structure or habits that help it adjust to its surroundings.
Eco-system based Adaptation (EbA)	EbA incorporates biodiversity and ecosystem services into an overall adaptation strategy to help people adapt to the adverse effects of climate change. ³
Environmental and Sustainability Guidelines	Provide the ground rules for the environment, social, resource and energy-related assessment of projects proposed for financing by NEFCO.
Environment	The environment is the totality of all the external conditions affecting the life, development and survival of an organism.
Energy, Energy Efficiency	Subject matter, scope and definitions regarding energy and energy efficiency are as defined by EU Directive 2012/27/EU of 25 October 2012 on energy efficiency.
Environmental Impact Assessment (EIA)	An EIA is an analytical process that systematically examines the possible environmental consequences of the implementation of projects, programmes and policies.
Sustainable Development	Sustainable Development refers to development that meets the needs of the present without compromising the ability of future generations to meet their own needs (as defined by the World Commission on Environment and Development, Brundtland Commission, 1987). It assumes the conservation of natural assets for future growth and development.
Sustainability	Sustainability refers to: (a) the use of the biosphere by present generations while maintaining its potential yield (benefit) for future generations; and/or (b) non-declining trends of economic growth and development that may be impaired by natural resource depletion and environmental degradation.
Green growth	Green growth refers to fostering economic growth and development while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies. ⁴⁵
Resilience	Resilience refers to the capacity of people to learn, share and make use of their knowledge of social and ecological interactions and feedback to deliberately and effectively engage in shaping adaptive or transformative social-ecological change. ⁶

² Definitions are based on OECD recommendations: <https://stats.oecd.org/glossary/index.htm> and EU Directives on Industrial Emissions (2010/75/EU), Energy Efficiency (2012/27/EU) and EU Directive on the assessment of the effects of certain public and private projects on the environment (2014/52/EU).

³ Lo, V. (2016). Synthesis report on experiences with ecosystem-based approaches to climate change adaptation and disaster risk reduction. Technical Series No.85. Secretariat of the Convention on Biological Diversity, Montreal, 106 pages.

⁴ NEFCO (2016) A Nordic Perspective on Green Growth – Nordic solutions as catalysts for global change, Oslo, 12 April 2016.

⁵ OECD (2011) Towards green growth – A summary for policy makers, OECD, 2011, <http://www.oecd.org/greengrowth/48012345.pdf>.

⁶ Arctic Council (2016). Arctic Resilience Report. M. Carson and G. Peterson (eds). Stockholm Environment Institute and Stockholm Resilience Centre, Stockholm. <http://www.arctic-council.org/arr>.

1. Introduction

NEFCO can only finance projects which have a positive effect on the environment/climate and promote a sustainable development. The main focus of NEFCO's project financing is to generate cost-effective environmental benefits of interest to the Nordic countries. This includes the promotion of green growth and prevention of climate change by supporting Nordic investments in environmentally sustainable solutions within both the private and the public sector. The overarching aim of NEFCO's operations is to contribute to the reduction of pollutants and improve energy and resource efficiency, both renewable and non-renewable. This is achieved through the financing of projects which are deemed to result in, inter alia, a reduction in emissions to water courses, a reduction in air pollution including greenhouse gas emissions and improved processing procedures for waste and chemicals. NEFCO primarily finances projects that are deemed to have a direct or indirect positive cross-border environmental impact for the Nordic countries, in addition to the positive impacts that can be achieved locally and globally. NEFCO also finances projects for which the environmental impact is restricted to the local area, where a desired reference or model-specific effect is achieved.

NEFCO's operations cover all types of actions that can lead to the prevention and/or reduction of negative environmental impact and/or to wider environmental security through, for instance, improved environment and climate benefits, energy and resource management, the introduction of different environmental and energy-related standards and/or products, or the modernisation of industrial processes.

Adaptation forms an important part of the climate change agenda. In order to increase the resilience of NEFCO's financing operations and protect it against potential negative environmental impacts, including climate change, NEFCO applies risk-reduction measures in its operations. For projects that are particularly vulnerable to negative climate change impacts, the climate and environmental risks are considered and mitigation and adaptation measures are incorporated into the project design and operations.

These Environmental and Sustainability Guidelines set out the principles applied to assess projects to be financed by NEFCO's own capital (the Investment Fund). In addition, NEFCO manages a number of trust funds. Each of these trust funds is governed by separate Investor/Donor funding/facility agreements which may set out specific environmental priorities and purposes. Depending on what has been agreed with the Investors/Donors in the funding/facility agreements, these Guidelines may also be applicable to assess projects to be financed through NEFCO's trust fund activities.

NEFCO, along with the other European International Financial Institutions (IFIs), is a signatory to the Declaration on European Principles for the Environment (EPE). According to the EPE, the European IFIs are committed, subject to each IFI's respective environmental policies, to apply EU principles, practices and standards, in their operations, also outside the EU.

In addition, NEFCO's *Sustainability Policy*⁷ provides guidance on the basic environmental and social requirements to be applied to projects in which NEFCO is involved.

NEFCO's *Methodology for Calculations of Environmental and Cost Benefits Regarding NEFCO's Project Portfolio*⁸, which provides further information on the specific methodology applied by NEFCO when evaluating the **environmental, resource and energy benefits** of project proposals, is annexed to these Guidelines.

Normally, every project enquiry and application NEFCO receives is assessed up front from an environmental and sustainable, resource- (including energy) efficiency point of view by NEFCO's Environment and Technology Unit. Section 3 below describes the environmental procedures which are applied and form the basis of NEFCO's environmental assessment.

2. Purpose and Objectives of the Guidelines

The purpose of NEFCO's environmental assessment procedures is to ensure that projects financed by NEFCO promote the Sustainable Development Goals⁹ and comply with the appropriate international, regional and local standards and the environmental requirements of the host country and, in particular, that:

- these procedures are followed throughout the project approval, implementation and completion process;
- potential environmental liabilities are addressed and appropriately mitigated;
- all relevant mitigation measures, efficiency improvements as well as adaptation and resilience aspects are identified and considered;
- environmental and energy costs are estimated along with other costs and liabilities; and
- all significant environmental, energy and resource efficiency, and sustainability issues are adequately addressed.

In general this means that measures are taken:

- to verify that all the projects to be financed have a direct or indirect positive environmental and sustainability impact on local/global as well as the Nordic environment;
- to promote in all of its activities environmentally sound and sustainable development;
- to promote energy efficiency and renewable energy and facilitate transformation from fossil fuels (coal, oil and gas) to renewables. Where feasible alternatives do not exist the investment is designed, where reasonable from a technological and cost perspective, to be able to be converted for future renewable energy use, so as to avoid lock-in effects;
- to identify and quantify positive environmental impacts, resource and energy improvements in the projects to be financed and to ascertain that possible negative environmental impacts are identified and assessed and all relevant mitigation measures are considered; and
- to adopt adequate environmental and energy assessments, management planning, audits and monitoring procedures throughout the project's activities.

⁷ Available at www.nefco.org/.

⁸ Available at www.nefco.org/.

⁹ SDGs of particular relevance for NEFCO's work are: SDG6 Clean water and sanitation, SDG7 Affordable and clean energy, SDG8 Decent work and economic growth, SDG9 Industry innovation and infrastructure, SDG11 Sustainable cities and communities, SDG12 Responsible consumption and production, SDG13 Climate action, SDG14 Life below water, SDG15 Life on land and SDG17 Partnerships for the goals.

The objective is to identify the need to add environmental covenants into the financing agreements. The need for environmental covenants may arise from the outcome of the environmental assessment of the project proposal and this, in turn, may trigger a need to include remedies in cases of non-compliance in financing agreements.

3. Environmental Procedures

NEFCO's Environmental Procedures (EP) normally include the following steps: (1) Review of the Request for Environmental, Resource and Energy Information; (2) Environmental and resource review(s) of the project proposal; (3) Environmental, resource and energy reporting; (4) Project progress and completion reporting (PCR); and (5) Post-project environmental evaluation.

The EP is further described in Sections 3.1 to 3.4, which provide more detailed information on the process and requirements applied to evaluate the environmental impact of project proposals seeking financing from NEFCO. Generally, applicable EU Directives¹⁰ are used as they provide good general guidance on the subject matter of industrial emissions and energy efficiency, respectively.

3.1 Request for Environmental, Resource and Energy Information

NEFCO's initial involvement in a project occurs at different stages of project development. NEFCO can be approached for financing either: (1) before a feasibility study has been prepared or (2) after the completion of a feasibility study. In both cases, the project proponent must provide NEFCO with sufficient information about the environmental and sustainability aspects of the project to allow for project screening. This information is needed to enable NEFCO to prepare an 'Indication of Interest' document and determine the level of additional environmental information, including that related to energy and sustainability, required for possible financing. Any initial requests for financing of a proposed project should also include a summary of the key environmental and sustainability issues associated with the project proposal. The key issues to be addressed are as follows:

- environmental benefits and positive impacts of the project on the local/global and Nordic environment, e.g. resource and energy savings, emission reductions, labour, adaptation and resilience benefits;
- possibilities for transformation from use of fossil fuels to renewables;
- anticipated possible negative impacts of the project and proposed environmental/energy and resource controls/technology and/or adaptation measures (e.g. EbA) to mitigate such possible negative impacts;
- potential environmental liabilities/concerns associated with the project or the property; and
- available environmental information, such as environmental and energy audits (EAs and EnAs), relevant costs and/or environmental impact assessments (EIAs).

¹⁰ Industrial Emissions Directive 2010/75/EU of 24 November 2010 and Energy Efficiency Directive 2012/27/EU of 25 October 2012.

3.2. Environmental and Resource Review

After receiving satisfactory Environmental, Resource and Energy Information, NEFCO proceeds to conduct an Environmental and Resource Review (ER) of the project based on the environmental, sustainability, resource and energy information provided by the project's proponent ('client').

To justify NEFCO's participation in the financing of a project, the environmental benefit to the Nordic countries has to be sufficiently significant. The **environmental and resource benefits** are generally analysed in terms of how cost-effective an investment is compared with similar ones in the Nordic countries. The ER is done by NEFCO's Environment and Technology Unit for the purpose of the final financing decision by NEFCO.

The ER is often based on the results of an Environmental Impact Assessment (EIA) or, as relevant, an Environmental Audit (EA) as well as further information sought from the client. An Energy Audit (EnA) can also be part of the EA. In case no EIA or audits are needed, NEFCO may apply project-type specific environmental, resource and energy review questionnaires/checklists developed by NEFCO to collect the relevant information from the client for the ER. The information provided by the client, in response to these checklist questions, is thereafter reviewed and assessed. NEFCO may also make a visit to the project site.

In the ER, NEFCO evaluates **the environmental impact, resource, energy and sustainability** aspects of the proposed project and provides the list of indicators to be used for the assessment of and reporting on the project if it is to be approved for NEFCO financing. The ER also provides the basis on which these indicators have been selected, calculated and need to be reported on by the client. The ER is normally conducted on a sectorial basis (e.g. municipal water, industry, energy, waste, agriculture). In principle, however, the method is the same for all project proposals. The environmental impacts and efficiency aspects are assessed in broad terms by also taking into account cross-media effects.

A project proposal's environmental and sustainability impacts are quantified through a number of **indicators**. Annex II depicts the typical environmental indicators used for NEFCO-financed projects. The situation prior to the implementation of a project is used as the starting point for benchmarking. The expected reductions and improvements are calculated during the pre-study or the business planning stage. The actual reductions and improvements resulting from implementation are then compared quantitatively with the expected levels and the levels prior to implementation.

NEFCO uses two primary methods to evaluate the environmental benefit and cost-effectiveness in relation to investments: (1) Calculation of the marginal cost, so-called Unit Abatement Cost (UAC); and (2) The environmental payback time. These methods are described in more detail in *NEFCO's Methodology for Calculations of Environmental and Cost Benefits Regarding NEFCO's Project Portfolio*¹¹ (Annex X).

In addition to determining the specific environmental indicators and the calculation of the environmental benefit of the proposed project, NEFCO evaluates the social aspects of the proposed project, as specified in NEFCO's *Sustainability Policy*. The social aspects cover,

¹¹ Available at www.nefco.org.

inter alia, social sustainability, resilience, human rights, labour practices, gender, the rights of consumers and communities, green growth as well as occupational health and safety.

The recommendations and conclusions from the ER should provide answers to the following questions:

- Are there any environmental, resource and energy-related concerns which suggest that NEFCO should not proceed with the project proposal?
- Are there any specific environmental covenants which need to be included in the financing agreements?

The specific guidelines on the two-stage ER and project categorisation regarding NEFCO's Investment Fund are presented in Annex 1.

3.3. Environmental, Sustainability and Project Completion Reporting

The client's reporting on the environmental and sustainability indicators of NEFCO-financed projects allows NEFCO to compare the actual project impacts before and after implementation of the project (comparison between ex ante and ex post).

Clients that have benefited from NEFCO financing of their projects are required to provide an **Environmental Status Report (ESR) to NEFCO, or similar**, after a project implementation has been finalised. NEFCO, together with the client, defines the specific indicators that are to be reported and the frequency, normally annually, of the ESR regarding the project. This reporting obligation is specified in the financing agreement. The reporting needs can also be trust fund specific following the mandates of different trust funds.

The report should monitor any eventual differences between the expected and actual achieved environmental, resource, energy and sustainability indicators of the project. In the event that the actual impact or improvement is significantly less than expected, an investigation is required by NEFCO to evaluate the underlying reasons. NEFCO's right to demand that the client remedy any default is described in the financing agreements to ensure that the expected environmental benefit and performance indicators agreed to are achieved. To ensure that the reported environmental and performance indicators are reported on in a reliable and accurate fashion, at least two persons from NEFCO's Environment and Technology Unit or an accredited external consultant will review the reported figures before the report is accepted. When necessary, NEFCO will visit the project site, and the results will be audited by NEFCO's Environment and Technology Unit or the designated consultant.

In the case of non-compliance by the client with the obligations of the financing agreement, the client will be requested to take corrective action within a set time frame. The consequences in cases of non-compliance may include, as relevant, suspending disbursement, immediate repayment and/ or notifying the proper authorities and co-financiers that may also apply remedies.

The client may need to report on the progress of the project implementation as well as when a project has been fully implemented (and financially closed), whereupon the project owner (client) should submit a final Project Completion Report (PCR). A PCR template [t.b.d.] can be used for the purposes of reporting on progress and completion, as relevant.

3.4. Post-Project Environmental and Sustainability Evaluation

At the completion¹² of a project, NEFCO's Environment and Technology Unit will review all the environmental, resource and energy efficiency, and sustainability information and prepare a post-project environmental evaluation report that summarises and evaluates the actual positive and negative impacts of the project. The Post-Project Environmental and Sustainability Evaluation forms an integral part of the general project evaluation. The post-project evaluation process should firstly establish whether the project has in fact achieved the expected overall beneficial objectives and, if not, what lessons there are to be learned. Secondly, it should assist in determining whether the environmental and sustainability procedures have been implemented effectively.

¹² For example: after a loan has been repaid, exit has taken place or, in the case of grants, after the agreed number of years of environmental reporting.

Specific Guidelines – NEFCO’s Investment Fund

For the Investment Fund, NEFCO’s Environmental Review is carried out in a step-wise process. The review starts with a Preliminary Environmental Review (pER) of the proposed project and is followed by a more detailed Environmental Review (ER). The pER is made in connection with giving the proposed project internal NEFCO approval and allowing the proposed project to be moved from the ‘Indication of Interest’ stage to seeking financing from NEFCO.

During the pER stage, the project proposal’s environmental impact, resource and energy efficiency, and sustainability aspects are screened preliminarily and the project proposal categorised as described below. Usually, the pER identifies the need to obtain supplementary information, which is then sought from the client to enable NEFCO’s further Environmental Review (ER) of the project proposal.

Project categorisation

If a project proposal proceeds beyond the Indication of Interest stage, NEFCO will initiate more in-depth screening of the project proposal to determine the nature and extent of the environmental and sustainability-related work required for NEFCO’s financing criteria to be met. This screening serves two purposes: (1) to determine which project proposals need further environmental and sustainability consideration, and (2) to eliminate those project proposals which are likely to have environmental impacts and sustainability aspects that are unacceptable to NEFCO.

During this screening, two questions will be asked in relation to each project proposal:

1. Does the project need an environmental impact assessment (EIA)?

The purpose of an EIA, including, as appropriate, eco-based adaption elements, is to identify the scope of the project proposal, to assess its positive as well as possible negative environmental and sustainability impacts, and to identify and propose adequate mitigation measures, if needed. The content of an EIA is described in more detail in Section 4.2 below.

An EIA is normally needed for projects involving any of the following components:

- whenever required by law;
- development of a greenfield site;
- industrial development;
- public infrastructure projects (e.g. water supply, sanitation, transport, energy);
- projects which have the potential to cause environmental impacts outside the area occupied by the project.

An EIA is normally not needed for projects involving any of the following components:

- education (e.g. facilities, training);
- establishment of consulting and engineering firms;
- telecommunications;
- research;
- technical assistance;
- institutional development.

2. Does the project need an environmental and energy audit (EA)?

The purpose of an EA is to identify possible environmental, energy efficiency and sustainability concerns that may constitute **a potential liability**, either to the client or to NEFCO. The content of an EA is described in more detail in Section 4.2 below.

Based on the answers to the above two questions, the proposed project will be given two codes which will categorise the project as in further need of an environmental evaluation:

- A or B indicates whether the project requires an EIA (A) or not (B);
- 1 or 2 indicates whether the project needs an EA (1) or not (2).

Category A: The project may have diverse environmental impacts. An EIA is required. Large-scale industrial or infrastructure projects normally require a full EIA. Other projects may require a partial EIA that can be a separate study or part of a feasibility study.

Category B: The project does not have essential environmental impacts. No EIA is required.

Category 1: An EA is required.
An EA is normally required for projects that involve:

- expansion and modernisation of a property;
- transfer or lease of a property.

Category 2: No EA required.

The client and NEFCO should agree as early as possible, and normally immediately after NEFCO's approval of an Indication of Interest for the proposed project, on any required environmental, resource and energy assessment (EIA or EA), including schedule and contents (terms of reference), as appropriate. This is because the findings of the EIA or EA should be directly integrated into the project design. In many projects, especially those involving process modernisations, EIA and EA are often linked and overlapping. For example, an EA should not focus on issues of the present situation that are not relevant in the new situation or will be covered in the EIA.

Contents of an EIA and EA

Environmental impact assessment (EIA)

An EIA is a process for examining the environmental and sustainability impacts, both positive and negative, of a proposed activity and includes an assessment of the impacts relevant to adaptation and aspects of resilience. The EIA allows for the incorporation of appropriate measures to address risk mitigation and incorporate them into the project design and implementation. EIAs identify, describe and assess the direct and indirect effects of a proposed project on the following: a) human beings and resilience, fauna and flora; b) soil, water, air and the landscape; c) resource and energy assets; d) the cultural heritage; and e) the interaction between the elements referred to in points a), b), c) and d) above.

An EIA is an analytical process that systematically examines the possible environmental consequences of the implementation of projects, programmes and policies. An EIA attempts to predict the impact of a future action on the environment and provide this information to those who make the decision on whether to proceed with the project. The EIA is also a legally obligatory process for many projects in most countries, and it takes place before an action is carried out (ex ante).

Consent to proceed with the development of a proposed project which is likely to have significant negative effects on the environment or is unsustainable shall be provided only after assessments of likely significant environmental and sustainability impacts have been carried out. The assessments should be conducted on the basis of appropriate information supplied by the project developer, which may be supplemented by the authorities and by the public likely to be concerned by the project in question.

The EU Directive 2014/52/EU¹³ *on the assessment of the effects of certain public and private projects on the environment* gives good general guidance on the assessment of the effects of certain public and private projects on the environment.

The objectives of an EIA are to:

- ensure that direct and indirect environmental and social impacts, including impacts relevant to adaptation, are identified and addressed;
- evaluate alternatives to the proposed project;
- anticipate and avoid, minimise or offset the significant adverse physical, biological and social effects of proposed project operations;
- protect the productivity and capacity of natural systems and the ecological processes that maintain their functions;
- promote development that is environmentally and socially sustainable and that optimises resource use; and
- incorporate environmental and social measures fully into project design and execution.

When defining the comprehensiveness and the exact contents of the EIA, national or regional EIA regulations should be followed and the level and procedures of public participation should be defined. The review should also be co-ordinated with other financiers. The process and the results of the EIA are described in formal documents that are generally reviewed by appropriate national agencies, other stakeholders including the public, and by NEFCO. The client normally has the responsibility of preparing the EIA.

Audits (Environmental and Energy)

Whereas the EIA identifies, describes and assesses the direct and indirect effects of a proposed project, environmental audits (EA) identify the environmental and resource efficiency issues associated with existing or past business activities. Energy audits (EnA) and energy management systems may stand alone or be part of a broader environmental audit.

Auditing is used to check the sufficiency of existing practices and current activities (ex post). Audits are carried out in an independent manner by qualified and accredited experts according to qualification criteria (e.g. as provided for by the EU Directive 2012/27/EU on energy efficiency).

¹³ Available at <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014L0052&from=EN>.

An EA provides a ‘snapshot’ when looking at what is or has happened at a site. It includes observations, interviews and reviews of records to determine if there is reason to suspect contamination (e.g. toxic substances) or other environmental or energy-related liability (e.g. oil spills, fuel contamination) issues associated with a project activity. Some environmental, resource and energy-related information collected and evaluated during an EA may also form part of the financial and legal due diligence investigations.

Audits should preferably be carried out independently and by an accredited third party. In-house experts may be used provided that the competent authority concerned has put in place a scheme to assure and check their quality, including, if appropriate, an annual random selection of at least a statistically significant percentage of all the audits they carry out. Criteria for audits, including those carried out as part of environmental and energy management systems, may use the guidelines provided in relevant EU directives on energy efficiency and industrial emissions.

An EA should typically cover the following topics:

- Nature of the proposed project/context of the audit;
- Environmental, health and safety policies and procedures;
- Environmental, Resource and Energy management at the company/facility level;
- Health and safety aspects at the company/facility level;
- Conclusions and recommendations.



**METHODOLOGY FOR CALCULATIONS OF
ENVIRONMENTAL AND COST BENEFITS REGARDING
NEFCO'S PROJECT PORTFOLIO**

27 September 2017

NEFCO ENVIRONMENTAL METHODOLOGY

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Abbreviations

BOD	Biochemical Oxygen Demand
CH ₄	Methane
CO ₂	Carbon Dioxide
CO _{2e}	Carbon Dioxide equivalent
COD	Chemical Oxygen Demand
EBITDA	Earnings before interest, taxes, depreciation and amortisation
EMAS	The EU Eco-Management and Audit Scheme
FSC	Forest Stewardship Council
GHG	Green House Gas (including CO ₂ , F-gases [HFC, SF ₆ , PFC], ODS, CH ₄ , etc.)
GWP	Global Warming Potential ¹⁴
HM	Heavy Metals
HVAC	Heating, Ventilation, Air Conditioning
kWh	kilowatt hour
N	Nitrogen
N _{tot}	Total Nitrogen
NEFCO	Nordic Environment Finance Corporation
NH ₃	Ammonia
NO _x	Nitrogen Oxides (including NO ₂ , N ₂ O, etc.)
MAC	Mobile Air Conditioning
MP	Montreal Protocol
ODS	Ozone Depleting Substance
ODP	Ozone Depleting Potentials ¹⁴
P	Phosphorous
PAH	Poly-Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PM	Particulate Matter
POP	Persistent Organic Pollutant
RAC	Refrigeration and Air Conditioning
SO _x	Sulphur Oxides (incl. SO ₂ , SO ₃ , etc.)
SS	Suspended Solids
UAC	Unit Abatement Cost
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
VOC	Volatile Organic Compound

¹⁴ GWP (100 y) values are those used by UNFCCC: http://unfccc.int/ghg_data/items/3825.php; ODP values of ODS in accordance with Montreal Protocol Handbook: <http://ozone.unep.org/sites/ozone/files/Publications/Handbooks/MP-Handbook-2016-English.pdf> and with the Amendment to the Montreal Protocol as set out in Annex I to the Report of the Twenty-Eighth Meeting of the Parties, pp. 51-52; UNEP/OzL.Pro.28/12, 15 November 2016.

1. Introduction

To justify NEFCO's participation in the financing of a project, the environmental benefit to the Nordic countries has to be sufficiently significant. NEFCO's *Environmental and Sustainability Guidelines*¹⁵ describe the process and requirements for the evaluation of the environmental, resource and energy impacts of a project seeking financing from NEFCO. This document describes the specific methodology of how the environmental impact, in other words the **environmental, resource and energy benefits**, are calculated.

The environmental benefits of a proposed project are generally analysed in terms of how cost-effective an investment is compared with similar investments in the Nordic countries. The estimated costs for the Nordic countries are based on so-called Nordic (or selected European) shadow prices. The calculations, carried out by NEFCO's Environment and Technology Unit, are based on the EU's Seville Process Reference Protocol.¹⁶

NEFCO uses two primary methods to evaluate the environmental cost-effectiveness of investments: (1) Calculation of the marginal cost or so-called Unit Abatement Cost (UAC) and (2) the environmental payback time. Both methods use Nordic comparative costs, i.e. the Nordic (or selected European) shadow prices (see Appendix 1). The difference between the two methods is that the UAC is calculated separately for each environmental indicator, whereas the calculation of the environmental payback time includes the overall cost benefit accruing from the various mitigation measures achieved and allows for an overall summary of all environmental indicators, which means that the investment is measured by its overall cost-effectiveness.

The UAC calculation is used primarily when assessing the cost-effectiveness of selected indicators, e.g. carbon dioxide for energy projects or phosphorus and nitrogen for sewage treatment and agricultural projects. The reason for this is that there is a wealth of historical information regarding the cost-effectiveness of such types of projects. For most projects, the environmental payback time is also of significant interest for the purposes of analysing the cost-effectiveness of the project.

The calculation methods outlined above are applicable in all cases where the **indicators** are quantifiable or can be estimated, which applies to nearly all NEFCO projects. In cases where it is not feasible to quantify or estimate the cost-effectiveness or where the cost-effectiveness is very low, e.g. biodiversity projects, projects aimed at improving drinking water quality, certain industrial projects, etc., but where, nevertheless, the environmental and resource efficiency benefits are significant or in accordance with Nordic policies, an investment can still be considered to provide sufficient environmental benefit.

¹⁵ Available at www.nefco.org.

¹⁶ European Commission, DG Joint Research Centre, IPTS, Sustainability in Industry, Energy and Transport; European IPPC Bureau. Integrated Pollution Prevention and Control; Reference Document on Economics and Cross Media Effects, May 2005.

2. Environmental Indicators

A number of relevant indicators that describe the environmental and energy efficiency targets and enable follow-up evaluations must be agreed for each NEFCO project.

The indicators are quantified through available and accepted methods. In certain circumstances the indicator cannot be measured due to methods of analysis not being available or some other lack of information. Under such circumstances, current **indicators have to be estimated** or calculated based on known values from equivalent facilities/technological solutions (so-called 'emission factors'). In some cases it may be appropriate to introduce **a different indicator**, for example an environmental standard, e.g. EMAS or FSC, to achieve better environmental control, biodiversity, sustainable forestry, adaptation indicators as applicable, etc.

Under some circumstances only an **indirect environmental, including energy, impact** is achieved. Such impacts are achieved in, for instance, the next user stage, which is common for industrial projects. An example is the manufacturing of environmental equipment and equipment designed to achieve more efficient energy consumption. Another example is a Nordic company that starts production, e.g. through a joint venture, in one of the countries where NEFCO operates and via its production achieves a reduction in emissions from the actions of its customers in that country and, simultaneously, there is a transfer of new technological expertise that facilitates the switchover to more effective environmental actions. Other examples of an indirect positive environmental impact can be the offering of services within the area dealing with the environment and energy, such as consultancy services that contribute to the creation of improved conditions for the implementation of environmental actions. The indicators in these circumstances are based on estimates of the amount of equipment sold and replaced.

Environmental and resource efficiency indicators are selected to ensure that they help evaluate the **existing environmental resource and energy situation** prior to the implementation of the project. The selected indicators are followed up in the annual **environmental reporting process and the project completion report**.

Table 1 below provides a short summary of the most important environmental indicators for different sectors.

Table 1 Most important sector-specific environmental indicators

Sector	Environmental indicators	Comment
Municipal water and sewage treatment	BOD, COD, Ntot, Ptot, SS; more efficient resource usage (e.g. reduced water usage)	In certain circumstances NEFCO can participate in the financing of projects limited to potable water where this is seen as a pre-condition to allow future investments in relation to sewage treatment.
Energy	SO _x , NO _x , GHG, CO ₂ , heavy metals (HM), Hg, dust/particulate matter (including PM _{2,5} -PM ₁₀), black carbon, kWh; more efficient resource usage, radioactivity, certification, e.g. EMAS	The creation and emission of any type is handled through a combination of: <ul style="list-style-type: none"> • energy efficiency • process modification • choice of fuels that cause less polluting emissions when combusted • introduction of emissions control • improved resource, energy and waste management processes
Industry projects	Established on a case-by-case basis in relation to water, air and waste. POPs/HM, ODS, GHG, nutrients, black carbon; more efficient resource and energy usage, incl. the management of chemicals; certification, e.g. EMAS	Environmental impacts should be both direct and indirect.
Waste	Heavy metals, incl. Hg, ODS-GHG, incl. CH ₄ , CO ₂ ; SO _x , VOC, particles, NO _x , nutrients (N, P); PCB/POPs, reduced radiation (radon etc.)	The management of waste from households, industries, ashes and spent fuel from energy production as well as contaminated soil.
Agriculture, forestry	N, P, GHG, pesticides, CH ₄ , NO _x ; energy and resource usage, certification, e.g. EMAS, FSC	The choice of indicator depends on the type of project: <ul style="list-style-type: none"> • waste handling • water discharge • air-based effluents • effects from poisonous pesticides • ecological consequences • diseases • air-based effluents

3. Calculation of Unit Abatement Costs (UAC)

The following parameters are required when calculating investment UAC against a specific indicator:

The investment cost

The total investment, normally provided in EUR. Depending on the set-up of the investment, it may be relevant to limit the calculation to that part of the project which is financed by NEFCO. For example, if a factory is being renovated and NEFCO provides financing for enabling the building of a sewage treatment plant connected to the factory, it is reasonable to carry out a calculation solely based on the cost of the treatment plant.

Change in annual operational cost

This refers to the change in the situation before and after the project has been implemented and becomes operational. This parameter is primarily calculated in one of two ways: i) changes to EBITDA² based on a financial project analysis, or ii) calculation of the annual saving based on a technical analysis of the project.

*Annual emissions reduction/
resource efficiency gain*

The expected annual reduction in the indicator compared with the project baseline prior to implementation, normally expressed in a mass unit (e.g. kg, tonnes).

The first step in the calculation is to calculate an annual annuity for the investment. This requires both a repayment time/depreciation time ('capital recovery time') and an internal interest rate. For all projects using the UAC method, a UAC value is calculated using a repayment time/depreciation time of 10 years and an interest rate of 5%. The interest rate is in line with (or slightly higher than) what is generally used in the Nordic countries for similar calculations. When the investment has a long depreciation time, e.g. infrastructure projects, the socio-economic situation needs to be taken into consideration and it may therefore be justified to use a longer repayment time of up to 20 years when calculating the UAC.

The annual change in operational costs is deducted from the annuity-based investment cost. This subtraction is divided using the annual emissions reduction to provide a UAC value as per EUR/ton of emissions reduction. This is expressed as per the following formula:

UAC = annuity – annual change in operational costs (in certain cases EBITDA³) / emissions reduction

The calculated UAC value is then compared with the Nordic shadow (or selected European) price for the indicator to analyse the cost-effectiveness of the investment.

4. Environmental Payback Time

There may be cases when it is easier to calculate the environmental payback time than just the UAC of one component/pollutant. The Environmental Payback Time is primarily used in relation to projects where several quantifiable indicators are used, which then makes it possible to provide an analysis of the overall cost-effectiveness.

The first step in the calculation is to multiply the reduction in emissions from the various indicators against their respective Nordic shadow (or selected European) prices. The values are totalled, and the EUR amount indicates what the cost of achieving the same environmental impact would have been in the Nordic countries.

The total investment cost is then divided by the above sum to provide the environmental payback time. When calculating both the environmental payback time and the UAC, an analysis should be carried out as to what is reasonable in terms of the total investment cost.

In contrast to the UAC, no direct Nordic payback time exists for the comparison of the environmental payback time. According to NEFCO's guidelines, the environmental payback time must not exceed 10 years.

NORDIC SHADOW PRICES

This Appendix presents a summary of the Nordic (and selected European) shadow costs in relation to a range of emissions-reducing actions across different sectors as calculated by NEFCO's Environment and Technology Unit. The costs provided are average costs for the most common indicators in relation to NEFCO projects. Additional indicators for mercury emissions, for example, are available in relation to a large number of processes (industry and energy production). The costs are monitored regularly and revised when considered necessary by NEFCO. Normally NEFCO uses the lowest figure of the shadow price range (New EUR/unit; Table 1). There may be cases where another, higher value, may justifiably be used within the depicted range of the shadow prices From 2017 in Table 1, below.

Table 1 - Shadow Prices

Indicator	Sector	Unit	Until 2016 EUR/unit	Reference	From 2017 EUR/unit	Reference
CO ₂ /CO _{2-e}	Energy and industry projects	tonne	40	1	10–220	7,8,9,16
SO ₂	Energy and industry projects	tonne	1,5	2	3,900–6,500	8,9
NO _x	Energy and industry projects	tonne	4	2	1,400–8,700	8,9
BOD	industry/ livestock projects	tonne	320	3	70,000	15
Ntot, not agriculture	Municipal and industry projects	tonne	125	3	9,000–34,000	11, 12
Ntot, agriculture		tonne	37	4	7,000	8,9
Ptot, not agriculture	Municipal and industry projects	tonne	1,790,000	4	600–46,000	6,8,9
Ptot, agriculture	P-to soil (manure; fert)	tonne	2,739,000	4	600–72,000	8,9
NH ₃		tonne			5,000–12,000	9, 17
SS	Municipal and industry projects	tonne	10	3	128	15
Dust/particulate matter (covers PM10-PM2,5)	Industry and energy	tonne	10	3	460–2,300	8, 9
Heavy Metals	Industry & energy	tonne			183,000	8
Waste		tonne	100	3	125-180	9, 18
Energy (El)	Industry	MWh	20	5	27–600	10, 19
Energy (Heat)	Industry	MWh			22–36	10
Raw material/resource	Water use	tonne	2	3	1–2	10
Dioxin	Combustion	gram			92,000	9
PAH (Benzo-a-Pyren)	Combustion	gram			90	9
ODS	Industry/HVAC/RAC/MAC	tonne			30,000	9
VOC	Industry projects	tonne	5,000–10,000	3	300–15,000	8, 9,13,14

The figures are rounded off.

REFERENCES

1. The economic valuation of carbon. EIB and SEI. Unpublished report
2. The Swedish National Licensing Board. Sweden
3. Regional environmental publications 411, 2006. Development plan for water management in Birkaland.
4. Action and consequence analysis in relation to the introduction of environmental quality standards for phosphorus in lakes, Swedish Environmental Protection Agency report No. 5289 as well as Arheimer et al. *Ambio* 34, 7: 2005
5. Vartiainen et al. 2002. Gaia Group, ISBN 952-91-4465-2
6. Alistair Clark, Northern Dimension Environmental Partnership Pollution Reductions from Environmental Projects of the NDEP; Cost Efficiency of Reduction of Phosphorus Discharges; 6 Dec. 2013; <http://ndep.org/wp-content/uploads/131206-AC-presentation-web.pdf>
7. Trafikverket; ASEK_Analysmetod och samhällsekonomiska kalkylvärden för transportsektorn: ASEK 6.0; Version 2016-04.
http://www.trafikverket.se/contentassets/4b1c1005597d47bda386d81dd3444b24/hela_dokumentet_asek_6_0.pdf
8. Naturvårdsverket, rapport 6517, februari 2013; Klimatinvesteringsprogrammen Klimp 2003–2012 Slutrapport Redovisning till regeringen januari 2013. <http://www.naturvardsverket.se/978-91-620-6517-1>
9. Sander de Bruyn et al; Shadow Prices Handbook, Valuation and weighting of emissions and environmental impacts; Delft, CE Delft, March 2010. <http://www.ce.nl/>
10. Integrated Pollution Prevention and Control Reference Document on Best Available Techniques in the Slaughterhouses and Animal By-products Industries; May 2005;
http://eippcb.jrc.ec.europa.eu/reference/BREF/sa_bref_0505.pdf
11. Naturvårdsverket, rapport 5985 • JULI 2009; Sveriges åtagande i Baltic Sea Action Plan, Förslag till nationell åtgärdsplan; <https://www.naturvardsverket.se/Documents/publikationer/978-91-620-5985-9.pdf>
12. Linda Flyckt; 2010-12-16; Linköpings universitet; LITH-IFM-A-EX--10/2377—SE; Reningsresultat, drifterfarenheter och kostnadseffektivitet i svenska våtmarker för spillvattenrening;
https://www.iei.liu.se/envtech/examensarbete/utforda_examensarbeten?l=sv
13. Caroline Polders; VITO's Methodology for Selecting BAT & Determining BAT-AELs; Proceedings - Workshop likeminded in Stockholm 12-13 December 2016
14. Rijkswaterstaat, Ministerie van Infrastructuur en Milieu Infomil NeR Digitale NeR augustus 2014 8 augustus 2014; www.infomil.nl/publish/pages/64467/ner_augustus_2014.pdf
15. Integrated Pollution Prevention and Control (IPPC) Reference Document on Best Available Techniques for Intensive Rearing of Poultry and Pigs, July 2003;
http://eippcb.jrc.ec.europa.eu/reference/BREF/irpp_bref_0703.pdf
16. Marcantonini C. and Ellerman A.D. The Cost of Abating CO₂ Emissions by Renewable Energy Incentives in Germany, MIT CEERP, February 2013
17. Ammonia Emission Controls as a Cost-Effective Strategy for Reducing Atmospheric the Eastern United States, *Environ. Sci. Technol.* 2007, 41, 380-386
18. HRM:s avfallshanterings serviceavgifter fr.o.m. 1.1.2017

https://www.hsy.fi/sites/Esitteet/EsitteetKatalogi/jatehuollon_hinnasto_2017_ruotsi.pdf

19. International Energy Agency. "Projected Costs of Generating Electricity: 2010 Edition." ISBN 978-92-64-08430-8. 2010.

https://www.iea.org/publications/freepublications/publication/projected_costs.pdf