Introduction and application of ISO 14007 and 14008

ISO 14007 Guidelines for determining environmental costs and benefits
&
ISO 14008 Monetary valuation of environmental impacts and related aspects

Applied in a Case Study for a Stock Holding Investment Company

by
the Conveners of the ISO Workgroups in TC 207/SC1:

WG 7 - ISO 14008 Bengt Steen, Chalmers University of Technology, Gothenburg, Sweden and SIS

WG 8 - ISO 14007 Franz Knecht, CONNEXIS AG - ESG Advisory Basel, Switzerland, and SNV

09.11.2020

Content **Page**

1. Introduction - The need for ISO 14007 and ISO 14008

Creating a common language for socio-economic consequences of environmental impacts

Over the last 20 years, in many approaches to assessment uncovered evidence for the economic relevance of environmental impacts and related societal consequences. The evaluation of such impacts in tangible economic terms became a fundamental necessity for political, public and private decision making. This has been the case from discounting pure financial risks of environmental changes, such as Climate Change (CC) risk mitigation, to the valuation of a wide range of environmental impacts which have no ready price attached but are in fact monetizable. Setting the figures into the right context is the key step to understanding financial materiality, whether actively or passively involved. The other issue – perhaps even more dynamic in its consequences and outcome – is to consider both the financial and non-financial consequences. ISO 14007 provides the tools and methods for achieving this wholistic view. ISO 14008 is the standard focusing on the financial aspects, aiming at the monetary valuation, as far as possible, whether for single impacts or for the consequences of larger topics like CC.

In short, the two standards can assist in the following ways:

- Applying the **monetary valuation methods** described in ISO 14008 and a **wider cost-benefit analysis** approaches explained in ISO 14007 can help managers, financing entities and other stakeholders to better understand the whole picture of socio-economic consequences of environmental impacts and aspects of an organization.
- **Providing guidance on how to use environmental management data** (e.g. from ISO 14001 or other EMS in place) for assessing projects, assets and activities regarding economic and financial outcomes before, during or after realization.
- **Supporting management to determine the environmental economic rationale** for preparing investment decisions, whether for capital or operational expenditures (CAPEX or OPEX), and explaining/rationalizing strategic as well as operative options to internal and external stakeholders.
- **Helping external stakeholders**, e.g. debt or equity finance providers (e.g. banks) as well as direct investors, to improve their understanding of various environmental impacts and related trade-offs between options considered for financing.
- **Enhancing the ability to describe environmental impacts and their socio-economic outcomes** based on the **use of globally applicable standards** is of increasing importance when considering the growing interest of financial markets in general.
- **When several SDGs are to be considered**, hidden costs of e.g. environmental degradation expressed in monetary terms can help - in addition to creating the necessary long-term view - to define both objectives and cost-efficient measures. This may start by assessing e.g. the accountable amount of €/tons CO2 emitted, the surface of farm land (and thus for harvest/yield) lost, or the direct and indirect costs regarding effects on human health for example by a lack of access to clean water or even increased noise by road traffic.

2 Structure of the study

A case study was created to provide an overview of how ISO 14007 and ISO 14008 can be used. This case study highlights the main elements and addresses practical steps when considering the scientific and practical evaluation measures. The overview also provides examples of different data sources that can be used within, in some cases, from outside the organization.

This case study evolved in two steps, the first step was taken in 2018 to test the applicability: does the use of ISO 14007 and 14008 offer a viable process and, in the end, result in tangible figures? The second step in 2019 was to develop the case study further and explain the process of application and the use of the standard by focussing on monetary valuation. This was achieved by applying ISO 14008 to greenhouse gases and their economic impacts via climate change. A similar detailed application case for ISO 14007 is about to be developed as well, e.g. to support the linking with environment aspects-based SDGs.

The application case used in the following (pages 9 – 26) for the two standards concerns a fictious holding company. It 'owns' the stocks of four (actually existing) companies listed on Stockholm's OMX. The 'board of directors' of the holding company, alarmed by media coverage and a growing number of initiatives around climate change risks and financial market awareness, wanted to know the possible value corrections to the stock market pricing of the companies held from environmental impacts to the air (greenhouse gases). This 'climate change risk potential' is in fact much discussed recently and disclosure requests in particular for listed companies (but not only) already exist (e.g. in Sweden) and are growing (e.g. FSB-TCFD recommendations on climate-related financial risk disclosures or the EU-Taxonomy on green tech etc.).

The four companies chosen for this case study have a very different exposure to climate change, as would be expected in a non-sector focussed portfolio, although these types of portfolios would comprise a higher number of investments. In our case it consists only of 'real economy' companies: wind power user (wind parks), safety equipment (e.g. for ships), health care provider, and bathroom equipment.

The data used in the study were taken exclusively from publicly disclosed information of these corporations, available via their websites.

3. Intended use and user value of the standards

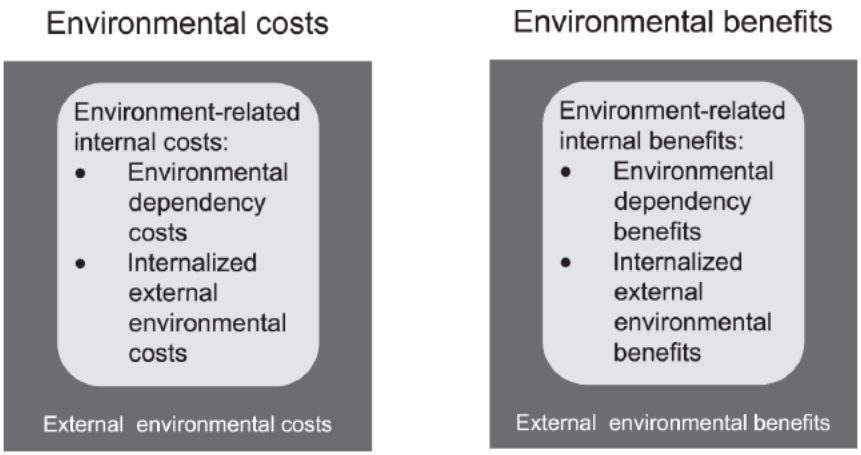
3.1 ISO 14007 Environmental Management - Guidelines for determining environmental costs and benefits

Intended use – scope

- The standard gives guidelines for organizations on determining the environmental costs and benefits associated with their environmental aspects. It also addresses the dependencies of an organization on the environment, for example, natural resources and ecosystem services, and the context in which the organization operates or is located.
- Environmental costs and benefits can be expressed quantitatively, in both non-monetary and monetary terms, or qualitatively.
- The standard also provides guidance for organizations when disclosing information.
- The standard takes an anthropocentric perspective, i.e. looking at changes that affect human wellbeing (utility) including their concern for, and dependence on, nature and ecosystem services. This includes use and non-use values as reflected in the concept of total economic value when environmental costs and benefits are determined in monetary terms.
- The ways in which the environmental costs and benefits are used after they have been determined are outside the scope of ISO 14007.

User value

- Providing **information** relevant or even essential for **decision making** by the management and the board of an organization, i.e. its owners.
- Supporting **financial review** as well as planning, and in particular when evaluating **CAPEX project alternatives** regarding 'hidden' effects.
- Applicable **before (ex-ante), during, or after (ex-post) evaluation** e.g. for a transaction or investment decision.
- Grasping the range of **internalized or externalized** environmental costs or benefits.



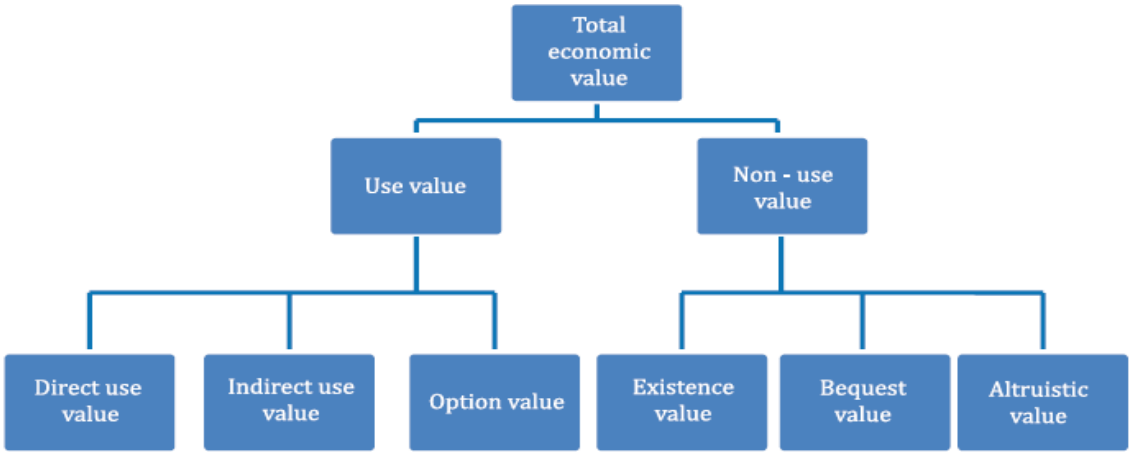
3.2 ISO 14008 - Monetary valuation of environmental impacts and related environmental aspects

Intended use – scope

- This standard specifies a methodological framework for the monetary valuation of environmental impacts and related environmental aspects. Environmental impacts include impacts on human health, and on the built and natural environment. Environmental aspects include releases to air, soil and water, and the use of natural resources and ecosystem services. The monetary valuation methods in this document can also be used to better understand organizations' dependencies on the environment and ecosystem services.
- In the view of the standard, monetary valuation is a way of expressing value in a common unit, for use in comparisons and trade-offs between different environmental issues and between environmental and other issues. The monetary value to be determined includes some or all values reflected in the concept of total economic value.
- An anthropocentric perspective is taken, which asserts that natural environment has value in so far as it gives utility (wellbeing) to humans. The monetary values addressed referred to in this document are economic values applied in trade-offs between alternative resource allocations, and not the absolute values.
- The standard does not include costing or accounting, although some valuation methods have the term "cost" in their name. The standard does not include the development of models linking environmental aspects to environmental impacts.

'Total economic value' as a core element of the standard

The elements of total economic value that a monetary valuation intends to capture aim to detail all elements of anthropocentric value that can be distinguished into use and non-use values.



Use values refer to the actual or potential, consumptive or non-consumptive, use of a good by a given individual. They are often divided into direct, indirect and option values.

Non-use values refer to the values individuals place on a good independent of the actual or future use they make of it. Three different elements are generally distinguished.

Application outcomes/results

Providing **information** relevant or even essential for **decision making** by the management and the board of an organization, i.e. its owners.

- Supporting **financial review** as well as planning, and in particular when evaluating **CAPEX project alternatives** regarding 'hidden' effects.
- Applicable before (ex-ante), during, or after (ex-post) evaluation e.g. for a transaction or investment decision.

4 Content of the standards

4.1 ISO 14007 Environmental Management - Guidelines for determining environmental costs and benefits

Content in sections and subsections

1 Scope

2 Normative references

- None

3 Terms and definitions

- Organizations and the environment
- Environmental economics and finance

4 Principles

5 Planning

- Defining the purpose of determining environmental costs and benefits
- Determining relevant sources and types of information
- Defining the scope
- Qualitative assessment
- Quantitative non-monetary assessment
- Quantitative monetary assessment
- Distinguishing internal from external environmental costs and benefits
- Considerations when determining environment-related internal costs and benefits
- Planning actions to determine environmental costs and benefits

6 Determining environmental costs and benefits

- Qualitatively assessing environmental costs and benefits
- Quantifying environmental costs and benefits in non-monetary terms
- Quantifying environmental costs and benefits in monetary terms
- Environmental damage costs and environmental benefits
- Environment-related internal costs and benefits

7 Application, reporting and continual improvement

- Cost-benefit analyses
- Aggregating environmental costs and benefits
- Reporting
- Continual improvement

Annexes (of informative use, not part of the standard)

- **Annex A** (informative) Flow chart on determining environmental costs and benefits
- **Annex B** (informative) Examples of selected terms and concepts

Bibliography

4.2 ISO 14008 - Monetary valuation of environmental impacts and related environmental aspects

Content in sections and subsections

1 Scope

2 Normative references

- None

3 Terms and definitions

- Environmental impacts and environmental aspects
- Environmental economics

4 Principles

5 Planning

- Goal of the monetary valuation and its intended audience
- Specification of the environmental impact or aspect
- People whose preferences and perspectives are considered
- Elements of the total economic value capture
- Monetary valuation method

6 Determining environmental costs and benefits

- Market price proxies
- Stated preference methods
- Value transfer
- Currency and base year adjustments
- Equity weighting
- Discounting
- Analysis of uncertainty and sensitivity

7 Linking monetary values of environmental impacts to related environmental aspects

8 Quality check

9 Reporting

Annexes

- **Annex A** (informative) Flowchart on an application of this document
- **Annex B** (informative) Example of assessing similarities for value transfer change in non-timber forest ecosystem services
- **Annex C** (informative) Monetary valuation in welfare economics
- **Annex D** (informative) Example of a database format

Bibliography

5 Introduction to the case study

The fictitious investment company chosen for this case study holds the stocks of four enterprises (in fact existing and listed on the Swedish OMX):

1. A wind power energy producer
2. A company manufacturing and selling safety equipment
3. A health care provider
4. A company manufacturing and selling bathroom equipment

The study evolved in two steps. The first step was to test the applicability, whether or not the use of the standards ISO 14007 and 14008 is offering a viable process and, in the end, results in tangible values.

The second step was to develop the case study further and explain the process of application and the use of the standard by focussing on monetary valuation. This was done by applying ISO 14008 to greenhouse gases and their economic impacts via climate change.

As actor – user of the two standards - a fictitious holding company was chosen which 'owns' the stocks of four existing companies listed on Stockholm's OMX. The board wanted to know the possible correction to the stock market value of these companies from environmental impacts to the air (greenhouse gases). This 'climate change potential' is in fact much discussed recently and disclosure requests in particular for listed companies (but not only these) already exist (e.g. in SE*) and are growing (FSB-TCFD, EU).*

As explained earlier, the four companies have a very different exposure to climate change, as it would be in a non-sector focussed portfolio. It consists of 'real economy' manufacturing companies: wind power (wind parks), safety equipment (e.g. for ships), health care, and bathroom equipment.

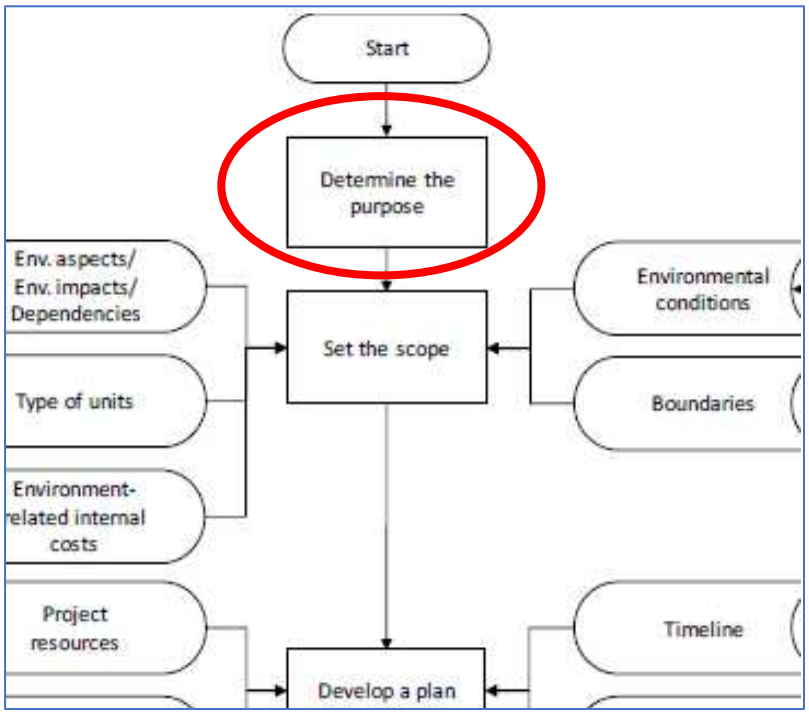
The data used in the study are taken exclusively from publicly disclosed information available via the website of these companies, which were of quite different quality in providing detailed and applicable data.

In both standards there are flowcharts giving an overview of the evaluation processes. In the following the addressed parts of the flowchart are marked with a red ring for showing where we are in the evaluation process. We start with the flowchart of ISO 14007 and proceed to 14008 to find the monetary values needed to determine climate related costs and benefits, and then return to 14007 to conclude.

6 Applying ISO 14007

6.1 Determine the purpose (clause 5.2 in the standard)

The first step when using ISO 14007 is to define the purpose of the study. In the context chosen for this case study the purpose is defined as: "to determine costs and benefits of emissions of greenhouse gases for investments of a stock holding company as first indicator for a possible need to adjust the inner value of these assets".

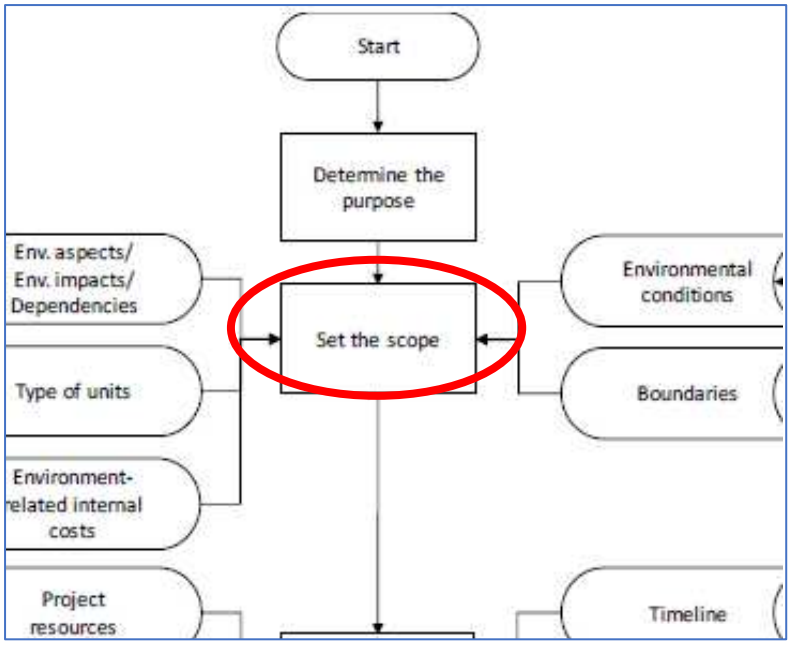


When applying this standard, the user is frequently asked to explain the motives for active choices. In the context of this case study the following reasons – purposes - were considered:

- The focus on greenhouse gases was chosen as climate change is today the most common and dominating topic for balance sheet correction due to environmental risk considerations.
- Costs and benefits determination in a wider context – monetary and non-monetary valuation as well as covering internalized and externalized impacts – aims at giving / allows to draw a more complete economic valuation picture beyond the accounting standards used today.
- The challenge for the stockholder with a long-term investment horizon is to identify what is not accounted for already and what is a value protecting, increasing or reducing factor for a particular company in his portfolio.
- The actual development e.g. on EU level or proposed by the TCFD regarding more transparency and disclosure for material but non-financial, yet economically relevant, aspects may be the tip of the iceberg challenge for the holistic evaluation of a balance sheet and P&L evaluation of portfolios.
- In the portfolio of the case study, greenhouse gases are of relevance for all four companies analyzed, although in different ways. When looking at the Sweden based windmill producer for electricity generation the topic is obvious and of direct relevance. When looking at the

other three, greenhouse gases may have a more dominant role in the value chain compared to the manufacturer's direct impact in Sweden. This is the 'new normal' of most companies depending on a global supply chain and with the aim to serve (or gain) global markets.

6.2 Set the scope



The second step is to set the scope of the study. The steps for scope definition are listed below (in **bold**) together with the scope chosen in the context of this case:

1. The **activities** assessed in the case are the emissions of greenhouse gases for each of the four companies in question.

2. The **reference situation** is zero company activity.

3. The **aspects considered** are emissions of greenhouse gases in tons CO2 equivalents.

4. The **impact pathways** are all pathways that are described in a quantifiable manner by IPCC and WHO. In another application crop yield or biodiversity pathways may also be of relevance.

5. **Spatial and temporal boundaries** exist both for aspects and for impacts. The spatial boundaries are global both for emissions and impacts. The temporal boundary is the year 2018 for emissions caused and 100 years for the impacts.

6. The **life cycle stages included** is cradle to grave. The companies own activities and supply chains are seen as their responsibilities and subject to economic risk for them.

7. The **perspective taken** is a societal perspective. The impacts are valued from the society's perspective.

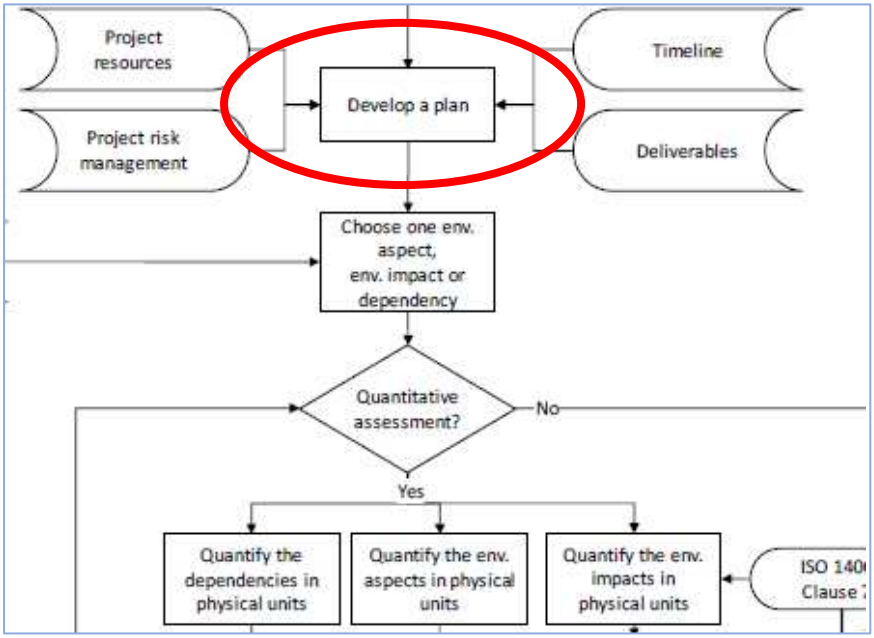
8. All **elements of total economic value** are considered, although some methods used measure only the 'use value'.

9. **Assessing internal or external costs & benefits:** the case considers only external costs and benefits. Internal costs and benefits are not considered, as they are (e.g. taxes, abatement costs) already covered by the internal financial accounting.

10. **Types of env. internal costs**: Internal costs for taxes, and abatement are not considered, as it is already covered by the internal accounting.

6.3 Planning actions to determine environmental costs and benefits

Having set the purpose and scope, the plan specifies what to do and how. Below is described what the plan should include (in bold) and how the issues are addressed.



Sources of information: The practical acquisition/collection of relevant data is today still the biggest challenge. Although there are many providers of general data, most companies have little or only limited understanding how to describe e.g. Scope 1, 2 and 3 of the GHG protocol. In the context of this case, the publicly disclosed annual reports were the main source of information together with public LCA databases. Questionnaires to the companies may be added in practice.

Roles & responsibilities: the management hires an LCA consultant.

Assessment of risks for project failure: besides data quality, project boundaries that are too narrow is seen as often observed risks for failure.

Timeline of actions and deliverables: Two months from start should be sufficient, except if there is a complex global supply chain involved, which has not yet provided any relevant data on the chosen aspect (here GHG emissions).

Provisions for monitoring: regular meetings to follow the project development are needed.

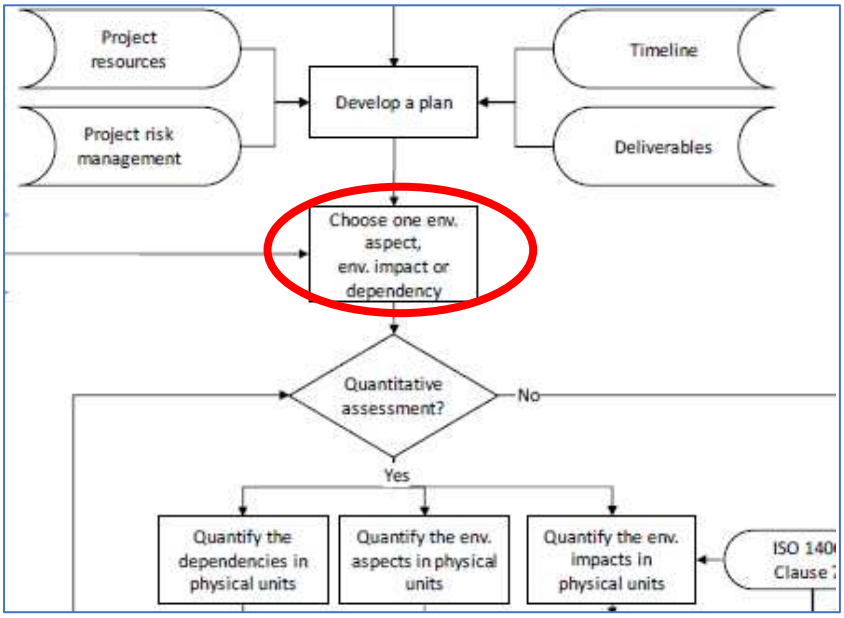
Provisions for quality check: a review by an independent (external) organization will not only support the project but also increase the value of external communication of the outcome.

Communication strategy: in the context of the case, results may be kept confidential or disclosed only to particularly interesting stakeholders, like other investors.

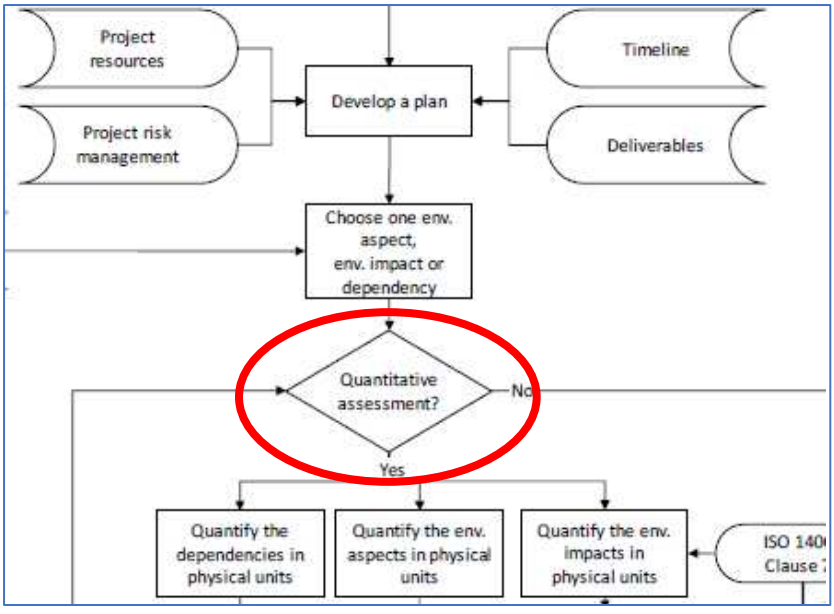
Continuous improvement: Decisions on revision or updates will be taken each 5th year.

6.4 Chose an environmental aspect, impact or dependency

Next step is to choose the aspects and impacts or dependencies to be assessed. In this case study, this was already done in formulating the purpose, when emissions of greenhouse gases were identified.

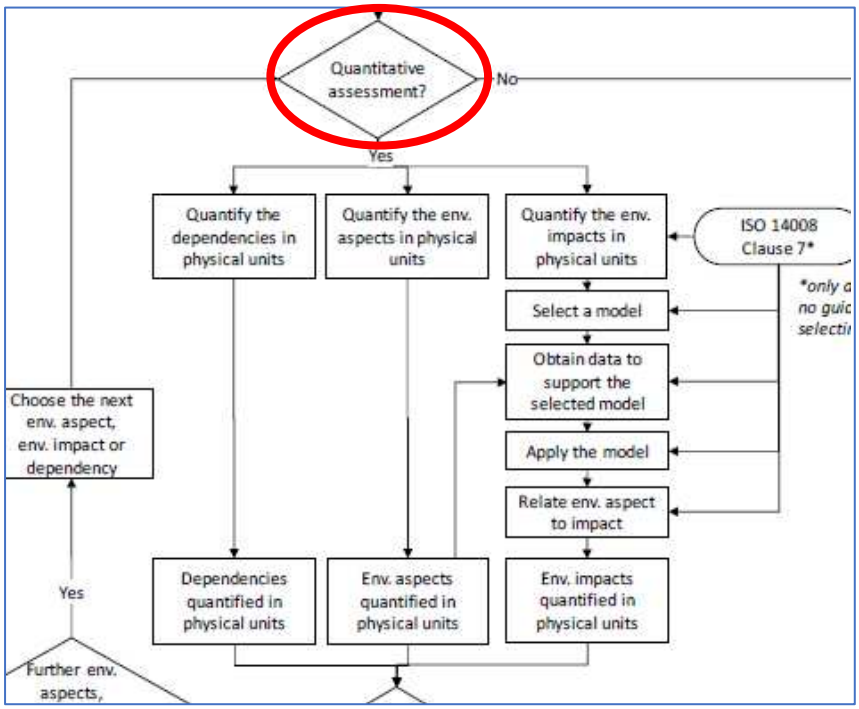


6.5 Quantitative assessment: Yes or No?



Both, qualitative and quantitative costs and benefits might be of interest. In the context of this case, quantitative assessments will be made.

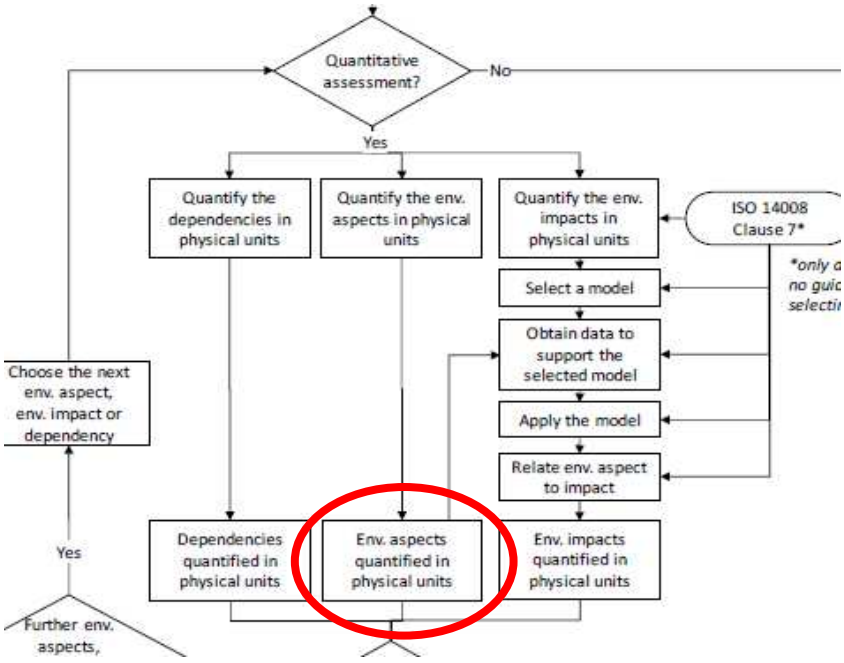
6.6 Type of quantification



The aim of the holding company (investor) is to estimate the monetary value of greenhouse gases as far as possible. The case has therefore to address first the respective environmental aspect – emissions to air - in physical units, as there is a later impact quantification only possible when the respective aspect quantification is done.

6.7 Environmental aspect quantified in physical units

CO_2 emissions are estimated in tons CO2e/year



- Company 1 Wind power: 7 300 tons CO2e /year
- Company 2 Safety equipment: 6 400 tons CO2e /year
- Company 3 Healthcare: 625 tons CO2e /year
- Company 4 Bathroom equipment: 5 000 tons CO2e /year

The emission of the wind power company is estimated from its reported electricity production and the Ecoinvent database on average emission from wind power production on a life cycle basis.

As none of the three other companies in the portfolio reported its own CO_2 emissions, the emissions for each company had to be estimated.

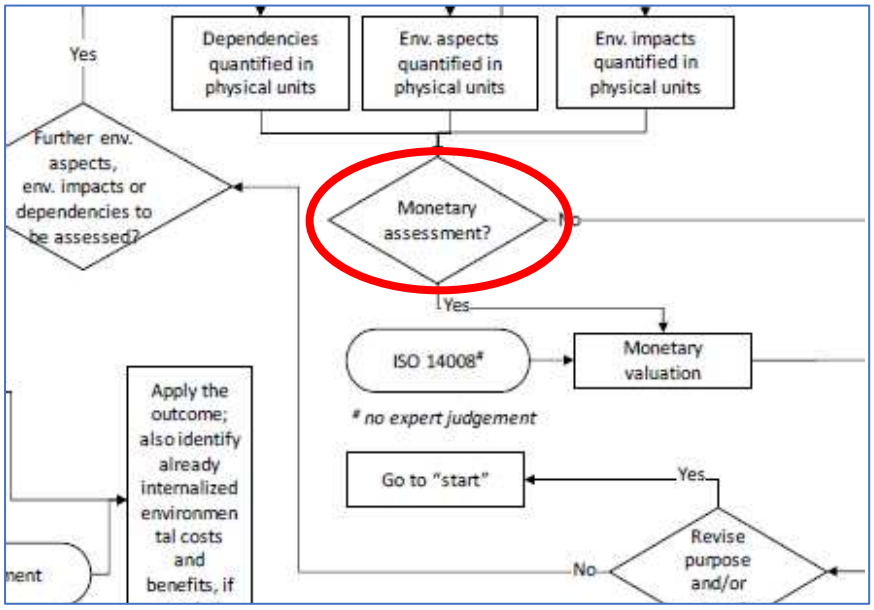
For the safety equipment-company the emissions were estimated on the basis of its turnover and the CO_2 emissions reported by a company in the same sector, which disclosed emissions per turnover of sold products.

Emissions from company 3 in the health care sector were estimated on the basis of the number of employees, their expected commuting, and the need for office space.

Emissions from company 4, bathroom equipment, were estimated again by use of its turnover and the CO_2 emissions reported by a company in the same sector.

6.8 Monetary assessment decision – according to the purpose.

Yes, monetary assessment will be made, as required by the goal of the study

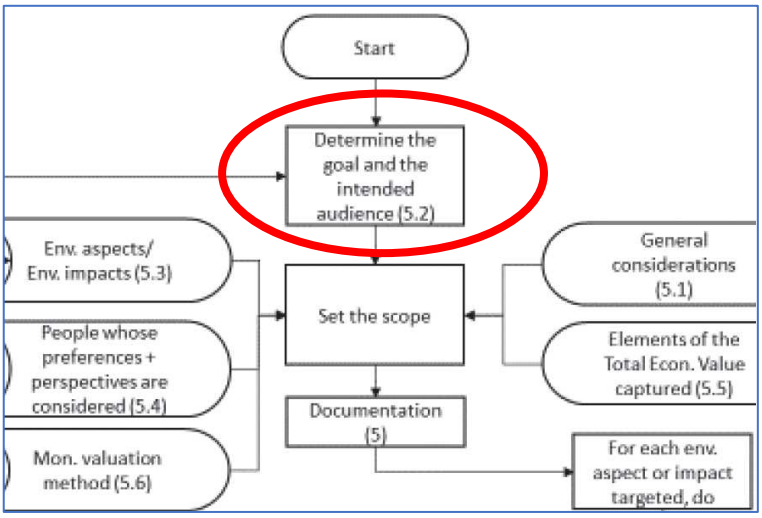


6.9 Monetary valuation

The ISO 14007 standard recommends the use of monetary valuation according to ISO 14008, which means that we start to follow the steps in 14008.

7 ISO 14008

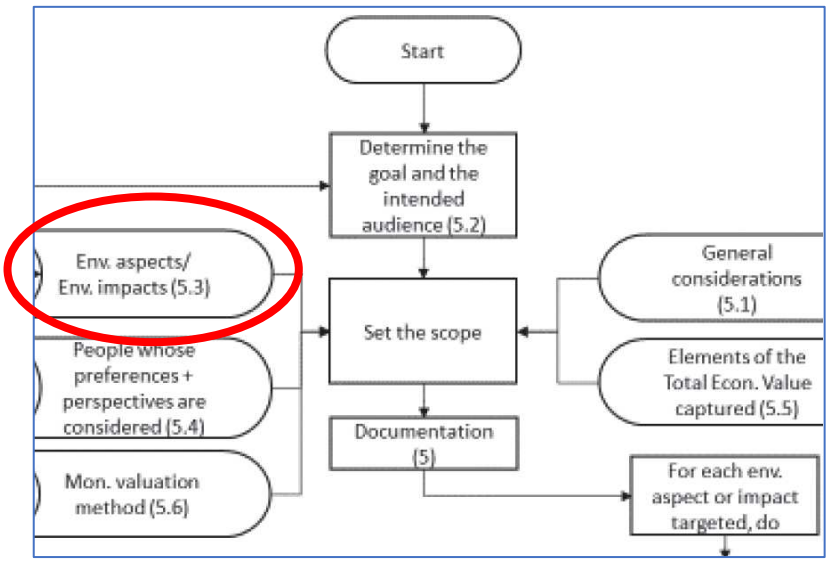
7.1 Determining the goal – applying the standard starts again with goal and purpose



The first step in the 14008 standard is to determine the goal, intended use, intended audience and way of communication.

- The **goal** is to determine damage costs of CO2.
- The **intended use** is to estimate potential extra costs for greenhouse gas emissions, first for internal asset value adjustment.
- The **intended audience** is the management of the investment company, respectively the board of directors, as they requested the management to do the determination.
- The **way of communication** is in the context of the case an internal report. Soon such information must be disclosed by listed companies, e.g. based on EU regulation or already existing transparency requirements by financial regulators, stock markets, or expectations by investors and their stakeholders (e.g. TCFD requirements).

7.2 Specification of the environmental aspect or impact



As a part of setting the scope, aspects and impacts need to be specified.

1. The **aspect selected** to be assessed is the emission of CO2.

2. **CO2 is chosen** as it represents a major topic for internalizing external costs.

3. The **impacts from CO2** selected to be valued are those that are reported by IPCC and expected to be of interest for monetary valuation.

4. Impact on human health and food supply via ecosystem services are selected for the valuation.

The cost of aspects (emissions and use of resources) and related impacts may be different regarding places and times, and due to different environmental conditions. Therefore, these must be specified. The cost of emissions also depend on which impacts, and impact pathways are included. Some of the information about the aspect, in this case CO2 emissions, is common to all impacts and are written on the top of the table. Some are specified for each impact, such as name, indicator, unit and impact pathway.

Spatial extent and resolution of impact: global

Temporal extent and resolution: 2010-2100

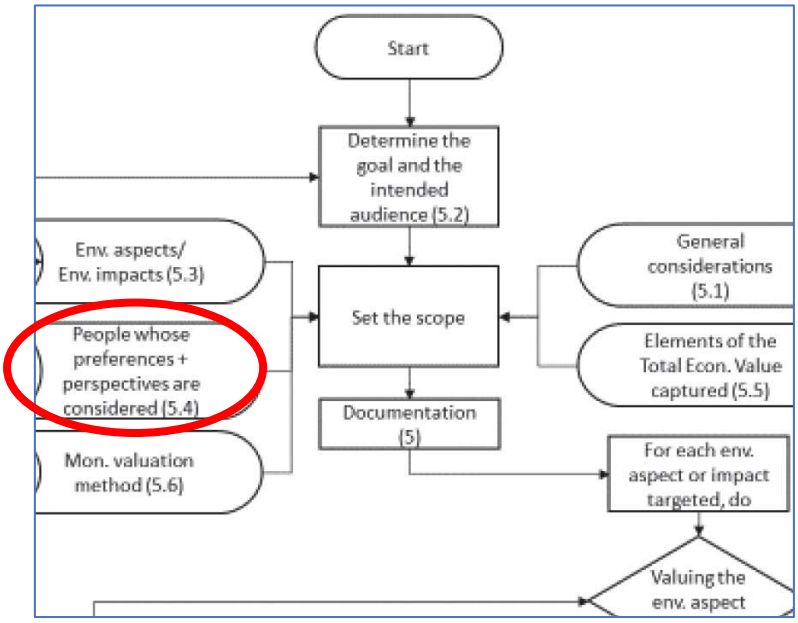
Environmental baseline: global status 2010

Type of sources: any source of CO2 emission

Specification of CO2 related impacts, impact indicators, units and impact pathways included in the valuation

Impact	Impact indicator	Unit	Impact pathway
Increased mortality	Decreased life expectancy (YOLL)	Person-years	Heat stress
Increased mortality	Decreased life expectancy (YOLL)	Person-years	Cold moderation
Increased mortality	Decreased life expectancy (YOLL)	Person-years	Undernutrition
Increased mortality	Decreased life expectancy (YOLL)	Person-years	Flooding
Increased mortality	Decreased life expectancy (YOLL)	Person-years	Diarrhoea
Starvation	Malnutrition	Person-years	Draught
Exhaustion	Reduction in working capacity	Person-years	Heat stress
Increased morbidity	Diarrhoea	Person-years	Polluted water
Decreased soil fertility	Decreased crop yield	kg	Draught
Decreased crop area	Decreased crop yield	kg	Sea level rise
Decreased soil fertility	Decreased Meat&fish yield	kg	Draught

7.3 People whose preferences and perspectives are considered – their values to be valued!

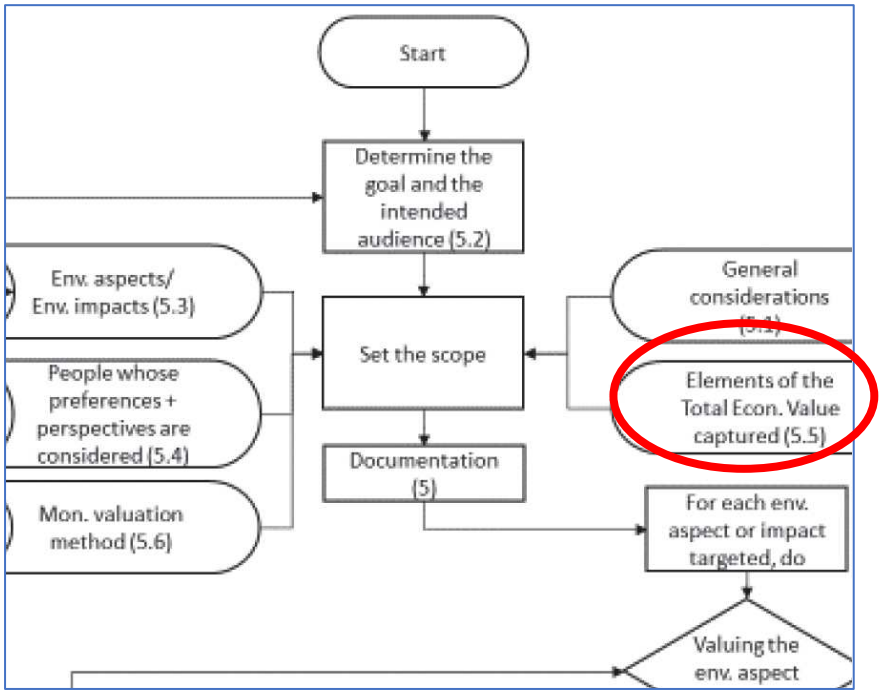


In setting the scope, monetary valuation requires to specify **whose values** are to be considered:

1. In this respective case the relevant **affected human population** are all people living globally 2010 to 2100.

2. The population **whose preferences and perspectives** are to be considered consist of people living in OECD countries 2010.

7.4 Elements of the total economic value captured - use value and non-use value



The scoping process requires a specification of what kind of values will be assessed. Although the total economic value consists of several types, the two main types are use values and non-use values.

In the respective case study both main types of economic value are to be captured in order to get the broadest range of economically tangible information for potential reasons to adjust the portfolio value.

7.5 Monetary valuation method

The last step of the scope setting in ISO 14008 is to choose monetary valuation methods. The table below presents the valuation methods chosen for the impacts and pathways identified in 7.2.

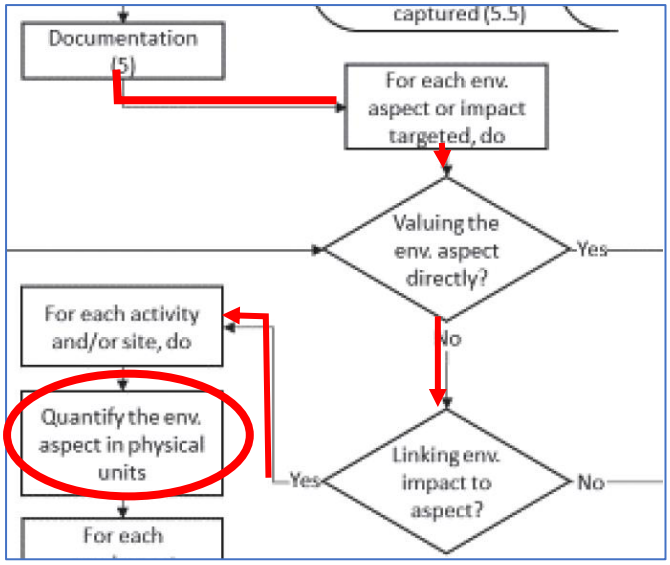
Values of Malnutrition and Diarrhea are calculated from 'disability adjusted life years', so called DALY values, which are used in health care to describe reduction of "ability", here interpreted as "working capacity". For the reduction in working capacity due to elevated temperatures ILO data is used.

Now the scope is set and documented.

Impact indicator	Valuation method
Decreased life expectancy	Market values (productivity)
Decreased life expectancy	Market values (productivity)
Decreased life expectancy	Market values (productivity)
Decreased life expectancy	Market values (productivity)
Decreased life expectancy	Market values (productivity)
Malnutrition	Market values (productivity)
Reduction in working capacity	Market values (productivity)
Diarrhea	Market values (productivity)
Decreased crop yield	Market values
Decreased crop yield	Market values
Decreased meat or fish yield	Market values

7.6 For each activity or site do: Quantify the aspect (=CO_2) in physical units

The next step is to quantify the aspect in physical units for each activity.



Company	Yearly CO_2-emission (ton)
1. Wind power	7300
2. Safety	6400
3. Health care	72
4. Bathroom	5000

The wind power company claims to cause a decrease of CO2 by emissions of 118,480 tons by replacing other sources of electricity. It is however unlikely that this will result in a future income to the company. It is more likely that risks of future cost will be limited to the cost of the emissions that actually occur in the life cycle. Such emissions can be estimated from LCA databases, such as Ecoinvent (https://www.ecoinvent.org/).

By use of Ecoinvent data the CO_2 emissions from construction, operation and waste management are estimated to around 7300 ton/year.

No emission figures were disclosed by the safety company. As a proxy, an average amount of CO_2 per turnover of sold products for a company in the same industry is used.

The emissions from the healthcare company is estimated on the basis of reported total headcount and assumed per capita staff commuting and energy consumption.

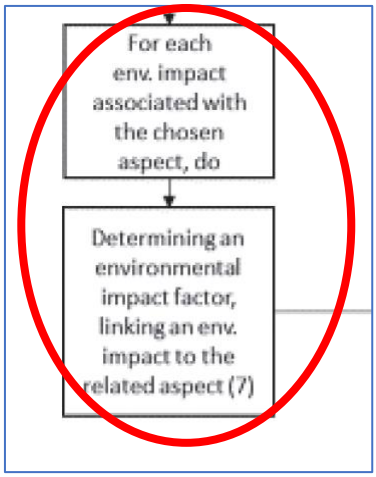
Emissions for the bathroom company was estimated based on turnover and emissions per turnover per sold products for a furniture retailer.

7.7 Determine environmental impact factors for 1 kg CO_2

In the context of the case, having quantified the aspects (emissions of CO_2) from the four different companies, the next step for monetarization is to calculate their impacts. The first step is to quantify the impact factors for CO_2 with respect to its different pathways and impacts. This is made by selecting literature data., which are shown in this table below.

The impact factor is defined as the number or amounts of impact indicator units per 1 kg CO_2 emitted to air. E.g. for each kg of CO_2 emitted, 0.014 kg of crop is lost due to climate change, which includes the impact on crop yield due to sea level rise.

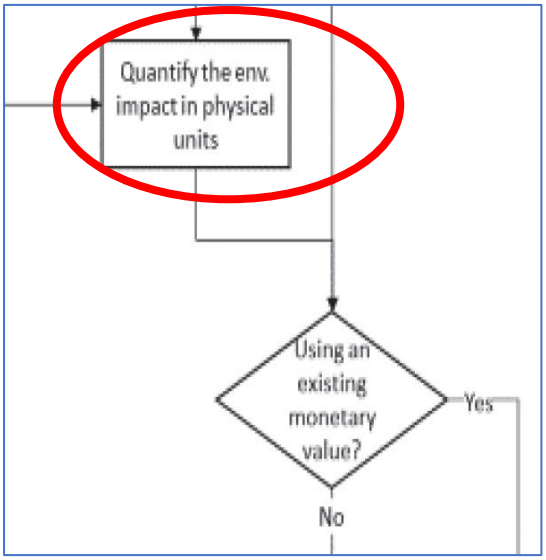
Impact indicator	Pathway	Impact factor
Decreased life expectancy, p-yr	Heat stress	2.65E–08
Decreased life expectancy, p-yr	Cold moderation	–4.16E–09
Decreased life expectancy, p-yr	Undernutrition	1.74E–06
Decreased life expectancy, p-yr	Flooding	1.66E–10
Decreased life expectancy, p-yr	Diarrhoeal diseases	1.21E–07
Undernutrition, p-yr	Draught	1.72E–06
Working capacity, p-hr	Heat stress	4.53E–03
Diarrhoea, p-yr	Polluted water	2.69E-10
Decreased crop yld, kg	Climate change	1.01E–02
Decreased crop yld, kg	Sea level rise	4.12E–03
Meat, yld. kg	Draught	3.72E–04



Impact factors linking environmental impacts to CO2-emission:

i.e. units of Impact indicators per kg CO2. Source: Steen. B., Monetary Valuation of Environmental Impacts: Models and Data, CRC press, 2020

7.8 Quantify environmental impacts in physical units



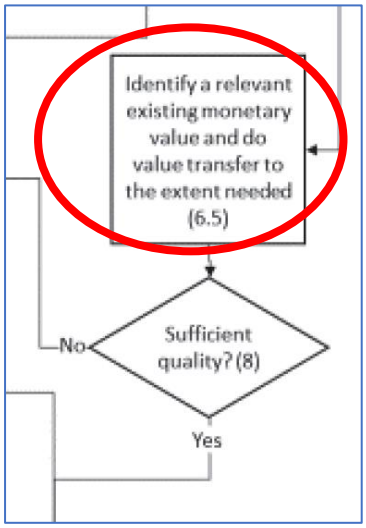
To quantify environmental impacts in physical units, the impact factors are multiplied with the CO_2 emissions estimated for the different companies to give impact values in physical units. E.g. the wind power company causes 0.193 years of lost life expectancy (YLL) due to heat stress. 0.03 YLL is gained in cold regions due to milder climate.

Impact	Pathway	1. Wind power	2. Safety	3. Health care	4. Bathroom
YLL	Heat stress	1.93E-01	1.70E-01	1.92E-03	6.46E-01
YLL	Cold moderation	-3.04E-02	-2.66E-02	-3.02E-04	-1.01E-01
YLL	Undernutrition	1.27E+01	1.11E+01	1.26E-01	4.24E+01
YLL	Flooding	1.21E-03	1.06E-03	1.20E-05	4.04E-03
YLL	Diarrhoea	8.83E-01	7.74E-01	8.77E-03	2.95E+00
Malnutrition, p-yr	Draught	1.26E+01	1.10E+01	1.25E-01	4.19E+01
Working capacity, p-hr	Heat stress	3.31E+04	2.90E+04	3.28E+02	1.10E+05
Diarrhoea, p-yr	Polluted water	1.96E-03	1.72E-03	1.95E-05	6.55E-03
Decreased crop kg	Draught	7.37E+04	6.46E+04	7.32E+02	2.46E+05
Decreased crop kg	Sea level rise	3.01E+04	2.64E+04	2.99E+02	1.00E+05
Meat, kg	Draught	2.72E+03	2.38E+03	2.70E+01	9.06E+03

Note: 2.33E-3 means $2.33*10^{-3}$

7.9 Identify relevant existing monetary values

Having quantified environmental impacts in physical units, monetary values of the impact is needed to find the total impact values. The valuation methods were identified in the scoping step (7.5).



The values determined are shown in the table below.

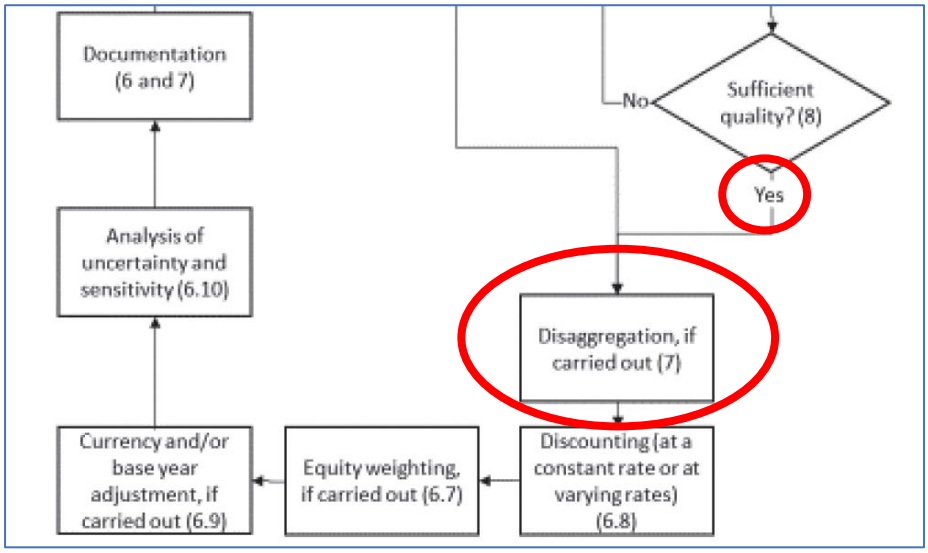
Impact indicator	ValueUS$	Valuation method	Value transfer
YLL	107067	Market value *)	No**)
Malnutrition, p-yr	6424	Market value *)	No
Working capacity, p-hr	30	Market value *)	No
Diarrhoea, p-yr	11242	Market value *)	No
Decreased crop yld, kg	0.289	Market value	No
Meat yld. kg	2.59	Market value	No

*) based on the average economic productivity in OECD. Disability impacts are corrected by DALY factors. DALY means “disability adjusted life years”.

**) Value transfer: ‘No’ means that the values are not transferred to another context, e.g. another country, time or currency.

Source: Steen. B., Monetary Valuation of Environmental Impacts: Models and Data, CRC press, 2020

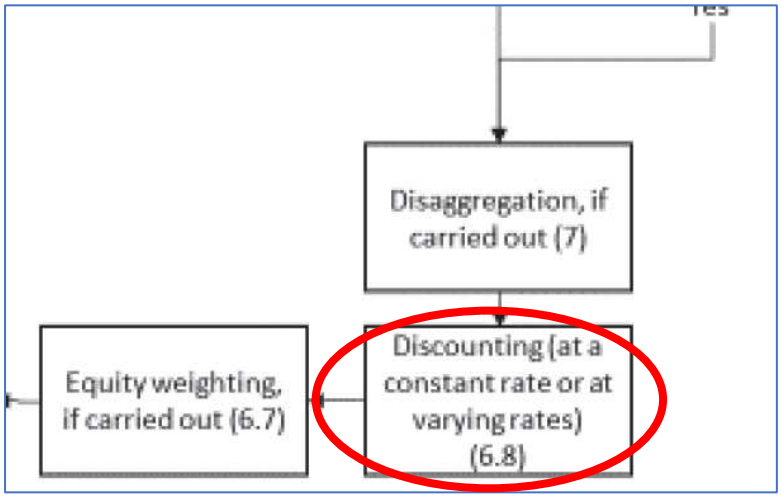
7.10 Consideration of quality and disaggregation



In many cases, the determination of monetary values of environmental impacts are made by using non-market values. The standard describes different methods for such a determination and defines what is required in specific documentation for how the assessment is done, including estimations for uncertainty. When performing an application of this standard the user has to take and communicate the decision whether the values obtained are of sufficient quality or not. In this case the assumption is taken that the values are of sufficient quality.

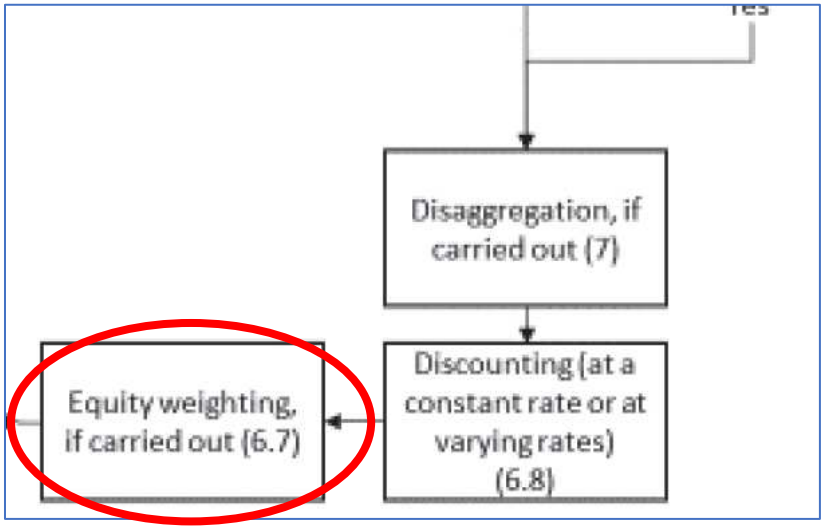
Sometimes monetary values are determined for the combination of several impacts, and there is a need to allocate part of the value to the different impacts e.g. due to specific interest (e.g. for documenting the amount of positive/negative impact identified). Such a disaggregation is to be justified/explained and documented. In the case of this example there is no disaggregation.

7.11 Discounting



If the impacts valued occur in the future, the values may be discounted to represent net present values. In the context of this case, the discount rate is set to zero. The reason is that health effects are likely to be valued at a constant rate vs income. People are likely to be willing to pay as much as they can to stay healthy.

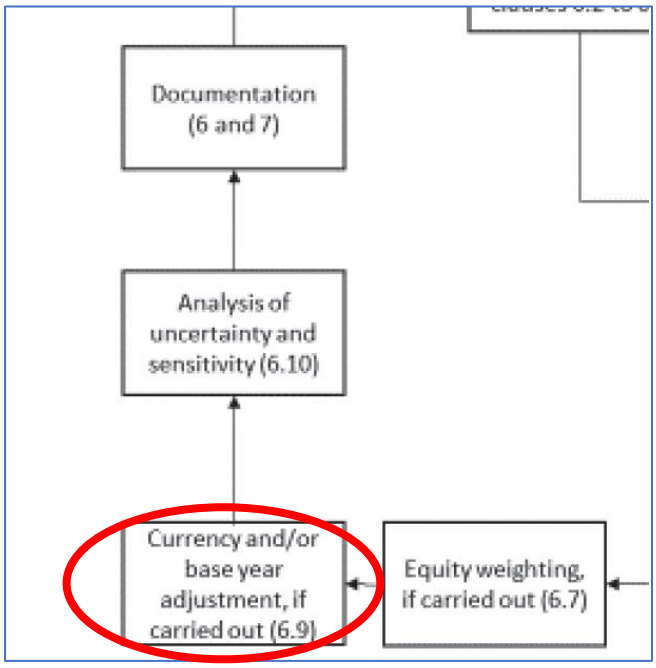
7.12 Equity weighting



The same amount of money may have different welfare implications for poor people and for rich. Therefore, equity weighting of some group's expressed values is made before aggregation with other groups.

In our case, no equity weighting is made. The reason is that the population whose preferences and perspectives were chosen to be considered (OECD 2010) represents all affected populations.

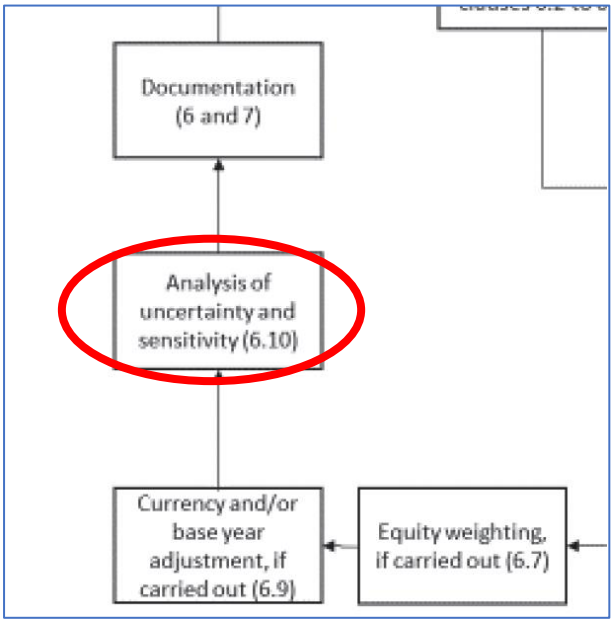
7.13 Currency and base year adjustments



If the impact valuation used is made in another currency and/or for another base year than the one used, currency and base year adjustment need to be made.

In the context of this case, no currency adjustments are made due to the type of investor (same country, same stock market listing, same currency). Also, base year adjustments are not made since the cost estimates are recent.

7.14. Analysis of uncertainty and sensitivity



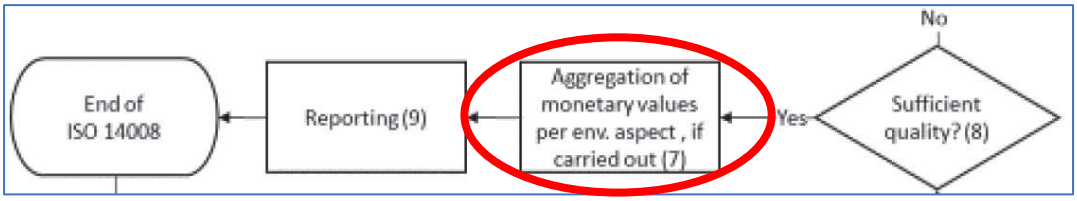
The standard requires uncertainty to be documented, as well as the factors to which the monetary value(s) are most sensitive.

A rough estimation of an uncertainty of a factor of three and log normal distribution is made on the basis of emission estimates, impact factors and impact values.

In this case study the IPCC reference scenario 6 is applied. Uncertainty relates to future development (e.g. temp. rise and crop yield).

The impact values for CO2 is most sensitive to the YLL from starvation and decreased working capacity due to elevated temperatures.

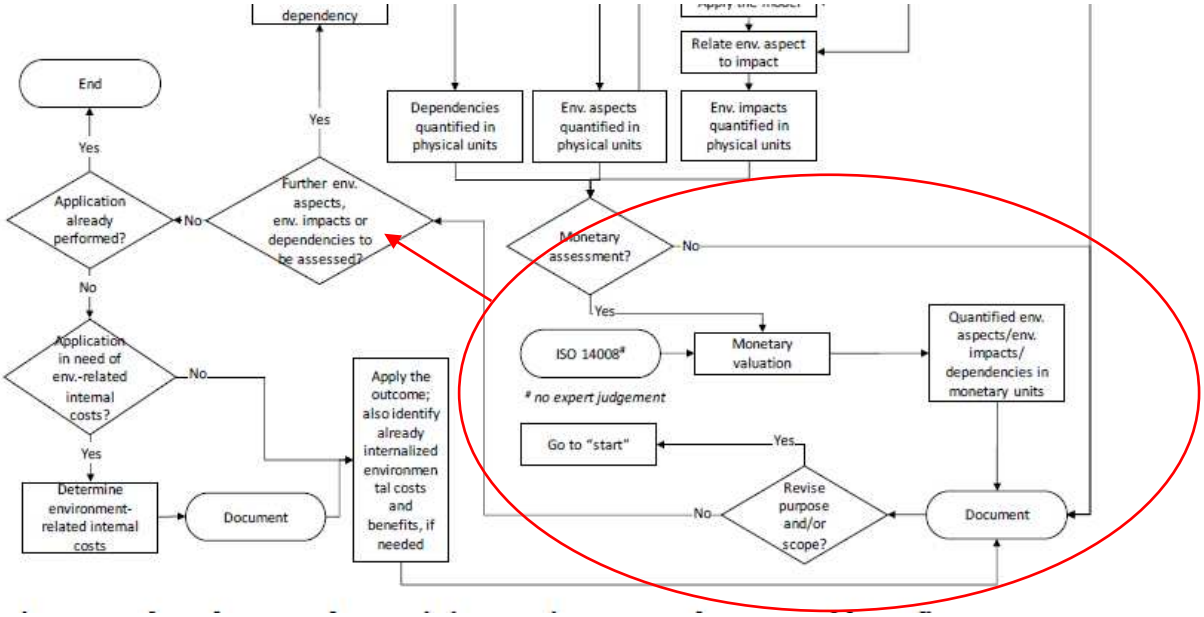
7.15. Aggregation of monetary values in €



Finally, the impacts in physical units (YLL, p-yr, p-hr or kg) are multiplied with the impact values in monetary units, in this case US$ to obtain the whole environmental cost of the company's activities. The table below shows the environmental impact costs and benefits for each company and pathway.

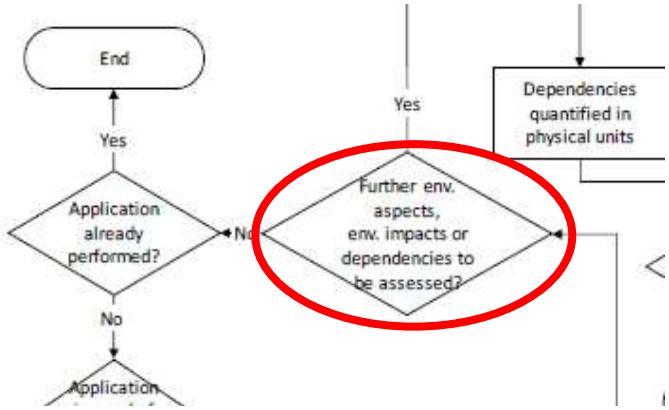
Impact indicator	Pathway	1. Wind power	2.Safety	3. Health care	4. Bathroom
Decreased life expectancy, p-yr	Heat stress	2.07E+04	1.82E+04	2.04E+02	6.92E+04
Decreased life expectancy, p-yr	Cold moderation	-3.25E+03	-2.85E+03	-3.21E+01	-1.09E+04
Decreased life expectancy, p-yr	Undernutrition	1.36E+06	1.19E+06	1.34E+04	4.55E+06
Decreased life expectancy, p-yr	Flooding	1.30E+02	1.14E+02	1.28E+00	4.34E+02
Decreased life expectancy, p-yr	Diarrhoeal diseases	9.46E+04	8.29E+04	9.33E+02	3.16E+05
Undernutrition, p-yr	Draught	8.07E+04	7.07E+04	7.96E+02	2.70E+05
Working capacity, p-hr	Heat stress	9.92E+05	8.70E+05	9.78E+03	3.32E+06
Diarrhoea, p-yr	Polluted water	2.21E+01	1.94E+01	2.18E-01	7.38E+01
Decreased crop yld, kg	Climate change	2.13E+04	1.87E+04	2.10E+02	7.12E+04
Decreased crop yld, kg	Sea level rise	8.69E+03	7.62E+03	8.57E+01	2.91E+04
Meat, yld. kg	Draught	7.03E+03	6.17E+03	6.94E+01	2.35E+04
	sum	2.58E+06	2.26E+06	2.55E+04	8.63E+06

8. Return to ISO 14007



When the monetary valuation for the impact goal regarding 'climate gases' are performed as described by ISO 14008, the next step would return to applying ISO 14007 by reviewing whether additional assessments need to be performed. This may be the case if the result of the monetary valuation has shown a need to enlarge the scope due to e.g. new factors or a change of stakeholder expectations

8.1. Further environmental aspects. impacts or dependencies?



In the context of the case, there was no need identified by the board to assess more environmental aspects, impacts or dependencies, as the purpose of the assessment was fulfilled, i.e. the calculation of a correcting factor, which means a correction for financial risk from future CO2-related expenses for the four stocks in question

8 Final remark

The example above demonstrates the systematic application of both standards. The comparative advantage to many schemes for sustainability rating of companies is the transparency and clarity about boundaries (scope) of such an assessment.

Despite that the chosen example is limited to the assessment of CO2 relevant emissions (only one aspect), the evaluation process is complex and thus requires both knowledge (EHS) and time for acquisition and compilation of relevant data. It is expected that software and databases will be developed to facilitate the process.

The authors of this study thank former members of both ISO Workgroups 7 and 8 for the valuable comments provided and invite readers to comment for any improvement. As it might be known, a new ISO standard is reviewed for changes after 3 years mandatorily.

The standards can be purchased via the official ISO website or any country member organization.