

Oiconomy Pricing: Scientific Challenges to the current version (2.04)

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Contents

1. General Introduction	5
2. Category: Pollution and Climate.	9
2.1 Introduction	9
2.2 Subcategory: Type A Pollution: Bulk Gasses & Climate change	9
2.2.1 Electricity.....	10
2.2.2 Fuels (industrial use)	10
2.2.3 Commuting	11
2.2.4 Business trips	11
2.2.5 Transport of goods.....	11
2.2.6 Subcategory Use-Pollution.....	12
2.3 Subcategory: Type B Pollution - Hard to measure agricultural emissions.....	12
2.4 Subcategory: Type C Pollution - Measurable chemical emissions.....	13
2.5 Subcategory: Type D Pollution (thermal pollution).....	13
2.6 Subcategory: Type E Pollution (incident caused pollution)	13
3. Category: Depletion.....	14
3.1 Subcategory: Minerals, botanical materials, animals.....	14
3.2 Subcategory: Fresh Water depletion	15
3.3 Subcategory: User Depletion	15
4. Category: Disposal/Waste	16
4.1 Subcategory Waste from Production.....	16
4.2 Subcategory Waste in User phase	16

4.3	Subcategory Waste at End-of-Life	17
5.	Category: Land Use	17
5.1	Subcategory: Land use for agricultural or forestry-for-food purposes.....	17
5.2	Subcategory: Land use for non-food forestry products.....	18
5.3	Subcategory: Land use for livestock derived products.....	18
5.4	Subcategory: Land use for non-agricultural products.....	19
6.	Category: Land Degradation/Biodiversity	19
6.1	Subcategory: Land Degradation and Biodiversity.....	19
6.2	Subcategory: Sea Degradation	20
7.	Category: Human Health (in the surrounding environment or in traffic)	21
7.1	Subcategory: Human Health & Safety (HHS)	21
7.2	Subcategory: User Health & Safety (UHS).....	21
8.	Category: Labour	21
8.1	Subcategory: Remuneration	21
8.2	Subcategory: Overtime	22
8.3	Subcategory: Child Labour	22
8.4	Subcategory: Inequality	23
8.5	Subcategory: Labour Conditions	23
8.6	Subcategory: Personnel Development	23
8.7	Subcategory: Employment contract time	24
8.8	Subcategory: Other Labour related aspects.....	25
8.9	Subcategory: Health insurance	25

8.10	<i>Subcategory: Occupational Health and Safety</i>	26
9.	Category: Social responsibilities and Animal Welfare	26
9.1	<i>Subcategory: Various Social Responsibilities</i>	26
9.2	<i>Subcategory: Animal welfare</i>	27
9.3	<i>Subcategory: Social responsibilities: user aspects</i>	27
9.3.1	<i>Instructions for use</i>	27
9.3.2	<i>Product Warranties</i>	28
10.	<i>Category: Corruption & Conflict</i>	28
11.	Category: Economic Responsibilities	29
11.1	<i>Subcategory: Fair Transactions</i>	29
11.2	<i>Subcategory: Transparency</i>	29
11.3	<i>Subcategory: Finance related criteria</i>	29
11.4	<i>Subcategory: Fair taxes</i>	30
11.5	<i>Subcategory: Subsidies</i>	30
12.	Positive impacts Bonus	31
	References	31

1. General Introduction

This document contains future challenges to the Oiconomy Pricing methodology.

Apart from the operational improvement in the OP Tool, we distinguish two major types of possible improvements:

Fundamental, theoretical, and methodological improvements

- M1 = adjustments to the current methods for specific aspects.
- M2 = additional elements for aspects not covered so far in the current version of the OP Tool and OP Standard.
- M3 = approved alternative certifications or forms of proof for reduction of data entry requirements.

The methodology is based on eight key principles, aiming at a valid, fair, inclusive and up to date representation of the real price.

We apply eight basic principles for the Oiconomy Pricing assessment:

1. It maps out all sustainability aspects related to the United Nation’s Sustainable Development Goals;
2. It discloses these aspects as much as possible for the entire value chain of products or services;
3. It discloses these aspects as much as possible on the basis of the actual actions of the parties in the value chain;
4. It translates the data on the actual actions of the parties in the value chain into the costs necessary for the prevention of the negative consequences for nature and society, as described in the United Nation’s Sustainable Development Goals;
5. The data collection and processing as referred to under 3 and 4 takes place on the basis of the most recent scientific insights and data sources;
6. The working methods in the assessment systems are available to everyone;
7. Companies and organizations wishing to use the systems for communications to third parties must accept independent verification of use by third parties (still to be developed);
8. Proposals for adapting (parts of) the assessment systems, within the basic principles set out in this article, are assessed and approved by a scientific committee to be set up by the Oiconomy Pricing Foundation.



So far, we developed Oiconomy Pricing for almost all aspects referred to under principle 1. But it is not fully finished and will be open for improvement. For this we invite the scientific community to contribute and make Oiconomy pricing a genuine Open Science effort. Various aspects are still missing and proposals for solutions are welcome:

- Thermal pollution
- Incident caused pollution
- User phase depletion and waste
- Land use for livestock
- Marine degradation
- Employment contract time
- Finance related aspects

Various other aspects may require better source data or partial adjustments.

We invite **scholars** (professors, postdocs, PhDs, master students) but also **experts in society** to contribute to the Oiconomy Pricing Research & Development agenda.

Please contact us at oiconomy@uu.nl for further details about the procedures.

Further look in this detailed list of challenges to the core methodology and excel tool:

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			
		+	1	Urgent: Various sections of the O.P.T. contain exceptions based on existing product- or company-certifications. An inventory of certificates and their scopes must be made, including an assessment if the covering of the relevant aspects are sufficient to justify an exception of ESCU allocations in the O.P.T.	
	+		1	Develop a company version of the O.P.T.	
	+		1	Standards per sector. Where necessary, a sector-specific version of this standard may be written. Sector organizations for groups of companies that are relatively simple and of similar nature may even write their own	

				<p>standards or code of practice and submit these for approval with an accreditation body. However, all these standards must answer to the umbrella Oiconomy Pricing Standard, the sector-standard must be approved by the O.F., and the participating organizations may not produce products other than the products covered by the sector standard.</p> <p>The background ESCU's represent marginal preventative costs, determined by the most expensive of preventative measures that need to be deployed to globally reach the relevant target and therefore, on average, will be higher than product specific costs.</p>	
	+			<p>Benchmarks.</p> <p>When enough product scores are available, the O.F. intends to present averages for product categories, which averages may be used to determine the relative ESCU score indicating the sustainability performance of the product compared to other products in the category.</p> <p>Note that both product scores and averages may be location dependent (for instance due to differences in transport distances and methods of collective disposal methodologies).</p>	
	+		1	<p>Defaults.</p> <p>Industry is challenged and expected to confidentially contribute to the creation and updating of O.F. default price factors in one of the following ways:</p> <p>Updating of O.F. default price factors by providing new information on preventative costs.</p> <p>Providing O.F. default price factors for more specific impact categories e.g. by aspect, industry sector, product group, conditions, processes or other aspects.</p> <p>New values for O.F. background price factors shall answer to the following criteria:</p> <p>The method described in (Croes and Vermeulen, 2015)*¹ shall be followed.</p> <p>O.F. default price factors shall be applicable for a large number of products. No background price factors may be introduced for the purpose of one or few products or organizations.</p> <p>Data and methods shall be verified by O.F. or an accreditation body.</p> <p>Provided data on preventative costs need to consider a measure providing a potential solution of at least 5% of global impact and provide an adaptation of the marginal preventative costs for the impact category. However, a new subcategory may be created, e.g. for the industry sector, limiting the 5% requirement to the impact within that industry sector.</p>	
	+		1	<p>Capital Goods</p> <p>The use phase of capital goods such as buildings, machines and furniture is included in section 12.5 of the Oiconomy Standard. But all capital goods must be or have been produced and will be disposed of while causing impact.</p>	

			<p>For new capital goods, the (un)sustainability related to their production and disposal shall be calculated and ESCU's allocated to products in the same ratios as the capital goods are depreciated, if they don't fall under de exemptions described in the sections 12.3.1. ESCU's shall be calculated based on the same depreciation allocations that the organization uses for cost allocations. No ESCU's need to be allocated if the total depreciation of all capital goods accounts for less than 20% of the product costs or the depreciation of the individual capital good accounts for less than 1% of the costs. ("individual capital good" shall be interpreted as the group of similar goods, e.g. all lift-trucks or all sowing machines). Because the average expenditures related to sales in the USA is around only 4,2 % (Stern, 2022), the production and purchase of capital goods in general do not contribute heavily to the unsustainability of products. However, the use of capital goods in the supply chain of products do, often heavily, but is already the subject of the sections of this standard.</p> <p>If capital goods are used for several products, the total ESCU's shall be divided over the different products, according to organization's own cost allocation procedures or in absence of such procedure proportionally to their financial turnover.</p> <p>The upstream supply chain ESCU-contribution of existing capital goods is theoretically zero, because the impact was in the past and cannot be prevented. However, because this causes disparity between new and existing capital goods, preliminarily, capital goods are exempted from ESCU calculations.</p> <p>However, this exception does not apply for capital goods for transport means, for production, transport or storage of renewable energy, water-, air- or soil- cleaning installations or other equipment specifically designed for sustainability impact mitigating reasons or if its major applications are for this goal, for information technology and for any other capital goods with an average product life shorter than 10 years. For products for which ESCU calculation of capital goods is required, this may be limited to the 80% of the involved capital goods (sorted by depreciation with highest on top). If involved capital goods are used for more than one product, ESCU allocations shall be proportional to organization's economic cost allocations.</p> <p>For existing capital goods that require supplier ESCU calculations, ESCU's shall be requested from suppliers at the next order of similar goods and assumed equal for the existing capital goods.</p> <p>For capital goods use-ESCU's are allocated for the full lifetime of the product. However, the user of the capital good already allocates these in the own ESCU calculations and do not need to be allocated again. However, the ESCU's for the upstream supply chain of capital goods need to be allocated, divided over the years of use, proportionally to the companies own depreciation methods.</p>	
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+				In various calculations we use the current practice in the top-20 best performing countries. This has been based on an assessment of methods applied to measure sustainability on the national scale. This has been done some years ago. The approach is described in (Croes and Vermeulen, 2016, sec. 3.2). This needs updating. Some of the reviewed methods have been adjusted or abandoned, others have been introduced. We need a new review to be able to (regularly) update the list of best performing countries.	
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2. Category: Pollution and Climate.

2.1 Introduction

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			

2.2 Subcategory: Type A Pollution: Bulk Gasses & Climate change

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			
+			2.2	The EcoCosts system and especially in Idemat, the ESCU's for the different midpoints are aggregated to result in the total ESCU's. E.g. Ecotoxicity, human toxicity and climate are aggregated. In the EcoCost methodology, based on impacts prevention (calculated as compensation with the leading indicator), this is understandable logic, but if the prevention is based on emission mitigation (which will be the goal and most likely measure), this methodology double-counts, because one mitigating measure prevents all types of impact. The O.P.T., in Pol.Data (used both for foreground and background calculations), where in most cases	

				<p>one and the same measure (usually prevention of the emission) prevents impacts on all midpoints, these ESCU's are not aggregated. However, it is important that always the highest of found ESCU's are allocated. Therefore, the EcoCost files are sorted by name and numbered, allowing the practitioner to directly see all values of a chemical in one view.</p> <p>In Idemat (only used for background calculations), where the EcoCosts may concern both different emitted chemicals and different midpoints, midpoint data are aggregated.</p> <p>Their choice is not consistent and may need reconsideration.</p>	

2.2.1 Electricity

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			
+			2.2.1	Considering the emissions for use of electricity via batteries, losses depend on factors like type of batteries and speed and charging mode (Reick <i>et al.</i> , 2021). These effects should be better specified. (Kostopoulos <i>et al.</i> , 2020), which calls for further research.	

2.2.2 Fuels (industrial use)

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			

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2.2.3 Commuting

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			

2.2.4 Business trips

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			

2.2.5 Transport of goods

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			
+			2.2.5	For transport of goods, Ecocosts for trucks are used based on one payload weight/volume ratio. Research under limited circumstances by the UK Transport department shows that 700 kg of payload weight affects fuel economy by 1%. Preliminarily, this is applied for all trucks and container transport	

				per ship only. Research is required for including the payload effect for other means of transport and possibly for various circumstances (e.g. driving up- or downhill).	

2.2.6 Subcategory Use-Pollution

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			
+			2.2.6	Use-Pollution: Currently, there are not enough data on use related emissions to create background data for the quantitative factor (emissions per time- or distance unit) on a reasonable amount of products or even product categories. Research is required.	
+			2.2.6	Added in Use-Pollution shall be the emissions involved by and during maintenance. Research required.	
+			2.2.6	Research is required to improve the granularity of “last-mile” data, accounting for distances and consumer behavior and transport means by country. Users of the O.S. system may be requested to provide these data.	

2.3 Subcategory: Type B Pollution - Hard to measure agricultural emissions

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			
+			2.3	Urgent: The section for indirect gas emissions still needs to be developed. Is an important omission and considers emissions like Nitrogen from farms, carbon from soil and clearing of forests, methane from barrier lakes.	

2.4 Subcategory: Type C Pollution - Measurable chemical emissions

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			
	+		2.4 / 3.2	<ul style="list-style-type: none"> • Urgent: Add an extra question on COD pollution, because that is easily forgotten. • Urgent: Investigate what the Idemat values for COD, expressed per kg. means (where COD is usually expressed in mg./liter). 	

2.5 Subcategory: Type D Pollution (thermal pollution)

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			
	+			Thermal Pollution: Investigate the potential preventative measures for the main thermal polluters (Mainly power plants) and the costs of these measures.	

2.6 Subcategory: Type E Pollution (incident caused pollution)

Improvement type			Section in OP Scientific	Description of possible improvement	Adjusted
M1	M2	M3			

			Justifications doc		
	+		2.6	Type E Pollution. "Fire is one of the highest and most polluting incidental risks. Investment and maintenance costs of sprinklers are on average about 3,5% of capital costs (....) although highly varying by sector. Depreciation costs are within a range of 1,0 - 17,7% of the turnover with an average of 3,5%, which results in prevention costs of 0,014% of the turnover, assuming an average 0,4% capital costs contribution to the product price. Above preliminary calculation is surely insufficient. Maximum Costs of prevention of incident caused pollution should be determined by industry.	

3. Category: Depletion.

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			

3.1 Subcategory: Minerals, botanical materials, animals

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			

3.2 Subcategory: Fresh Water depletion

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			
	+		3.2	Currently, the grey water footprint is not included (water depletion for returning polluted water to for instance a river), because it requires to calculate the amount of water necessary to dilute the pollutants to acceptable levels, for which a method needs to be found feasible for the supply chain actors and/or useful background data.	
+			3.2	Research requirement: The costs of water desalination and water transport need updating.	

3.3 Subcategory: User Depletion

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			
	+		3.3	User depletion: Currently, there are not enough data on use related depletion to create background data on a reasonable amount of products or even product categories. Research required.	

4. Category: Disposal/Waste

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			

4.1 Subcategory Waste from Production

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			
+			4.1	Assumed is that all waste for which no sustainable disposal can be demonstrated, ends up in soil. Of course, much of this ends up in water systems, but preliminarily it was too complex to account for this. Research and system adaptation is required. An option is to take the highest of both, but that may require a total reorganization and resorting of the involved databases of a better search-machine.	
+			4.2 / 4.3	The Oiconomy Pricing system needs background data on the costs of transport and processing of all materials disposed at industrial level for the production subcategory and at consumer level for the end-of-life subcategory, all consisting of the averages in the 20% best performing countries.	

4.2 Subcategory Waste in User phase

Improvement type			Section in OP Scientific	Description of possible improvement	Adjusted

M1	M2	M3	Justifications doc		
	+		4.3	Urgent: A section for Use-Waste is still lacking	

4.3 Subcategory Waste at End-of-Life

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			
+			4.2	Recycling requires processes that themselves may cause ESCU's. In addition, most recycling is "downcycling" if the value of the new material is lower than the original material or cannot be recycled indefinitely. Therefore, the O.S. divides the ESCU's of recycled waste flows between the creator and receiver of the waste proportionally to their value. The economic price of the waste represents the costs of external recycling and are included in the O.P.T. This method requires more study, because it is uncommon and requires a different definition of waste and recycling.	
+			4.2 / 4.3	The Oiconomy Pricing system needs background data on the costs of transport and processing of all materials disposed at industrial level for the production subcategory and at consumer level for the end-of-life subcategory, all consisting of the averages in the 20% best performing countries.	
+			4.3	Determine lifetime curves and the average redundancy factor for the different product categories.	

5. Category: Land Use.

5.1 Subcategory: Land use for agricultural or forestry-for-food purposes

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			

+			5.1 / 5.2 / 5.3 / 5.4	Because great trade-offs exist between biodiversity and land use, the O.P.T. assesses both biodiversity and yield, the yield as a measure of land use. Recently, using a different indicator for land use: m ² . years was introduced and data collected for a range of crops (Ledo <i>et al.</i> , 2018). Research is required into the advantages and disadvantages of using either of the 2 indicators.	

5.2 Subcategory: Land use for non-food forestry products

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			

5.3 Subcategory: Land use for livestock derived products.

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			
	+		5.3	AW: The section on Livestock needs to be developed. The Coolfarmtool may be very helpful and a quick solution!	

5.4 Subcategory: Land use for non-agricultural products

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			

6. Category: Land Degradation/Biodiversity

6.1 Subcategory: Land Degradation and Biodiversity

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			
+			6.1	Urgent: determine a scientifically sound, but for farmers feasible method, to determine the local biodiversity. The assessment of biodiversity is too complex for individual farmers. A preliminary method was included in the O.S., but probably most actors will probably use the very generic and simplified background data. Research is required to find and describe a simple instruction for biodiversity assessment.	
	+		6.1	Loss in carbon stock is currently not included in the tool, although other tools do (e.g. cool farm tool). For land degradation, currently Biodiversity, measured by the relative number of vascular plants is used. Also counting loss in carbon stock would be a type of double counting, although that is debatable. In addition, if added, how do we make the difference between Europe where forests were denuded ages or millennia ago and the amazon, being denuded now. An option is to use the year 1997, the year of the Kyoto Protocol after which one should have known better. This matter needs discussion and consideration.	
	+		6.1	Literature on costs of restauration is limited, not coordinated in methodology and very location- and ecosystem dependent. More data and Meta-analysis is required.	

	+		6.1	Commonly in LCA the emissions by land clearing are included, but a major question is for which land that should be done? In many countries, such e.g. in Europe, land has been cleared some centuries ago, in Brazil now. I propose to include the emissions by degradation and forest clearing after 1997, the year of the Kyoto Protocol and therefore the year after which actors should have known better. The Coolfarmtool works in a similar way but takes the year 2000 as limit.	
+ D3			6.1	Urgent: Research requirement: Global Databases/maps with numbers of locally natural vascular plants need to be investigated for suitability of providing natural biodiversity (preferably like the aqueduct atlas for water.	
+ D3				The EcoCost system provides a methodology based on the formula: $EcoCosts = X \times RC \times Q/Q_{threshold}$. Research requirement: Does this need to be the original ecosystem? What about invasive species? What about introduced species?.	

6.2 Subcategory: Sea Degradation

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			
	+		6.2	This aspect is still missing, needs to be developed	
	+		6.2	Determine the critical distance from corals and other sensitive ecosystems which belong to the ecosystem that should be preserved. The ESCU's allocated for sea degradation may not be realistic. Data on coral restoration have been used. (is extremely expensive), but data for other areas need research, as does the distance for non- MSC/ASC fishing from corals/kelp. In addition, there may be other types of sea that need specific ESCU allocation. Research required.	

7. Category: Human Health (in the surrounding environment or in traffic)

7.1 Subcategory: Human Health & Safety (HHS)

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			
+			7.1 / 8.10	Currently, the costs for measures for HHS are assumed equal to OHS. Find or determine average prevention costs specifically for HHS per industry.	

7.2 Subcategory: User Health & Safety (UHS)

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			

8. Category: Labour

8.1 Subcategory: Remuneration

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			

+			8.1	Urgent. Currently the O.P.T. calculates the FMW as the maximum of the statutory minimum wage (SMW) and the Oiconomy FMW. Research is required to also include the living wage in that maximum. Problems to study are the availability of living wages for countries and the frequency of updating. Potential sources are e.g. WageIndicator, GlobalLivingwage.org and Tak-Profit.org Also investigate salaryexplorer.com as source of income data. It seems still to contain data on the lowest paid wages based on yearly surveys.	

8.2 Subcategory: Overtime

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			
+				A database of overtime legislation by country shall be created.	

8.3 Subcategory: Child Labour

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			
+ T4			8.3	For inequality the difference between countries' WorldBank Purchase Price (PPP) was used to compensate for price level differences between organizations' persons working different countries. However, the WorldBank seems not to update the PPP's. Therefore, in the O.P.T. the PPP ratio was replaced by the ratio's in the GNI/capita. Research is required to investigate if this is the best choice.	

8.4 Subcategory: Inequality

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			
+				For inequality the difference between countries' WorldBank Purchase Price (PPP) was used to compensate for price level differences between organizations' persons working different countries. However, the WorldBank seems not to update the PPP's. Therefore, in the O.P.T. the PPP ratio was replaced by the ratio's in the GNI/capita. Research is required to investigate if this is the best choice.	

8.5 Subcategory: Labour Conditions

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			
+			8.5	Determine the maximum costs for optimal labour conditions, compared to average conditions in the country and industry sector.	

8.6 Subcategory: Personnel Development

Improvement type			Section in OP Scientific	Description of possible improvement	Adjusted
					ed

M1	M2	M3	Justifications doc		
+			8.9 / 8.6	Urgent: Currently, for health insurances and personnel development, goals are expressed in percentages contribution of the wage sum. But what if health insurance is relatively much more expensive than what a minimum wage can provide? And how to distinguish if this is evenly shared between high and low incomes?	
+			8.6	Research is required into the average company expenditures in the group or 20% best performing countries of their contribution to employee's personnel development.	

8.7 Subcategory: Employment contract time

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			
	+		8.7	<p>Research is required in the group of the 20% top performing countries on the legislation and practice about contract time. What job security is commonly provided, what contract time should be the target and what cost distance to that target can be allocated as ESCU's?</p> <p>For various labour aspects, preliminarily, the general O.S. methodology was not followed. The following research is required to consistently follow the methodology:</p> <p>Because a series of aspects are considered under one subcategory, according to the general system methodology, the preventative costs should be based on either:</p> <ol style="list-style-type: none"> 1. Study which of the relative impact of the issues and thereby the characterization factor per issue, to be multiplied by a defined factor of "1" for the gender wage gap. 2. Determine the actual preventative costs for each issue. 	

8.8 Subcategory: Other Labour related aspects

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			

8.9 Subcategory: Health insurance

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			
+			8.9 / 8.6	Urgent: Currently, for health insurances and personnel development, goals are expressed in percentages contribution of the wage sum. But what if health insurance is relatively much more expensive than what a minimum wage can provide? And how to distinguish if this is evenly shared between high and low incomes?	
+			8.9	Health insurance can be provided by the state. This should be excluded then, if the level of insurance is high enough. How can we determine this.	
+			8.9	For using the added value-based determination of health care costs, research is required into compensate the costs of the added value by country and possibly and industry sector. In addition, determined needs to be a method for cases where health care and insurance and health care is paid out of pocket, as reported by (Mills, 2014). Also we need to consider differences between state provided insurance and private insurance.	
+			8.9 / 8.6	If we work with averages for background wages, health insurance premiums and personnel development costs, how do we make sure that this also goes to the lowest paid workers and how do we address this in de tool?	

8.10 Subcategory: Occupational Health and Safety

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			

9. Category: Social responsibilities and Animal Welfare

9.1 Subcategory: Various Social Responsibilities

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			
+			9.1	The background ESCU's for various social aspects are calculated as a percentage of the 10 year average profit margin in a sector. However, for some sectors, that average is negative, which by this system covers up the present social issues. Negative margins are sometimes huge and hard to believe, e.g. for mining of metals. In the current tool, the ESCU's are minimized to zero, but that still does not value social issues. Research is required into these margins and possibly into another indicator.	
+			9.1	Because of abandoning of the governance measuring method for various social aspects, the PDCA and management review are lacking for various social aspects. It is probably better to find a way to add these back in another way. Best way may be to study the relative impact of the different issues, find marginal preventative costs for one of the issues and therefrom identify characterization factors.	

9.2 Subcategory: Animal welfare

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			
+			9.2	Determine for animal welfare more exact costs required for optimal welfare for all types of animals kept for consumption, test- or industrial purposes. Possibly (M Vissers, A van Wagenberg and M Baltussen, 2023) is useful.	

9.3 Subcategory: Social responsibilities: user aspects

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			
	+		9.3	Currently, there are not enough data on use-related social issues to create background data on a reasonable amount of products or even product categories. Research is required.	

9.3.1 Instructions for use

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			

+			9.3.1	Instructions of Use. There is no scientific justification for the current O.P.T. calculation of ESCU's for instructions of use. Research requirement: determine a better and justifiable way of valuing ESCU's for instructions of use.	

9.3.2 Product Warranties

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			
+				Without proper responsible warranties, ESCU's are calculated as follows: ESCU's = 2% of the sector average net operating margin. There is no scientific justification for this calculation of ESCU's. Research is required to determine a better and justifiable way of valuing ESCU's for providing responsible warranties.	

10. Category: Corruption & Conflict

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			

11. Category: Economic Responsibilities

11.1 Subcategory: Fair Transactions

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			
+				Research is required on the conditions of contract farming and other transactions between larger companies and LDS's and the extra costs to guarantee the weaker parties a fair income, in order to assess if the O.P.T. covers all frequently occurring relations between the parties.	

11.2 Subcategory: Transparency

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			

11.3 Subcategory: Finance related criteria

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			
	+		11.3	Finance related criteria are already proposed, but not certain enough to be included in the O.P.T. Research is required to determine financial criteria ESCU's and develop ESCU's.	

11.4 Subcategory: Fair taxes

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			
+			11.4	<p>Far Taxation: Huge amounts of Tax data are available, but complex. Research is required to improve and refine background ESCU's, preferably by industry sector and possibly other variables such as company size and country of head office. The current calculations only deal with tax avoidance by using international tax differences. A question is if also unfair taxation occurs in one country.</p>	

11.5 Subcategory: Subsidies

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			
+			11.4	<p>Subsidies to the company need to be added as ESCU's. However, if a subsidy has a specific goal of being used for personnel development, one could argue that the company did not get a subsidy and a part of personnel development is paid by that subsidy. This means that in the future section on subsidies, the allocated ESCU's are allocated as the balance of the obtained subsidy and the gap for the issue (in this case personnel development). Subsidies are not yet included but need to be in order to obtain objective ESCU scores without political interference. Research is required to develop an inventory on average subsidies per industry</p>	

				sector and country. Possibly, our participating organizations, by sharing their data on subsidies, can help creating a database.	

12. Positive impacts Bonus

Improvement type			Section in OP Scientific Justifications doc	Description of possible improvement	Adjusted
M1	M2	M3			

References

Croes, P.R. and Vermeulen, W.J. V. (2016) 'In search of income reference points for SLCA using a country level sustainability benchmark (part 1): fair inequality. A contribution to the Oiconomy project', *The International Journal of Life Cycle Assessment*, 21(3), pp. 349–362. Available at: <https://doi.org/10.1007/s11367-015-1018-0>.

Croes, P.R. and Vermeulen, W.J.V. (2015) 'Life Cycle Assessment by Transfer of Preventative Costs in the Supply Chain of Products. A first draft of the Oiconomy system', *J. Cleaner Prod.*, 102, pp. 178–187. Available at: <https://doi.org/10.1016/j.jclepro.2015.04.040>.

Kostopoulos, E.D., Spyropoulos, G.C. and Kaldellis, J.K. (2020) 'Real-world study for the optimal charging of electric vehicles', *Energy Reports*, 6, pp. 418–426. Available at: <https://doi.org/10.1016/j.egy.2019.12.008>.

Ledo, A. *et al.* (2018) 'Perennial-GHG: A new generic allometric model to estimate biomass accumulation and greenhouse gas emissions in perennial food and bioenergy crops', *Environmental Modelling and Software*, 102, pp. 292–305. Available at: <https://doi.org/10.1016/j.envsoft.2017.12.005>.

M Vissers, L.S., A van Wagenberg, C.P. and M Baltussen, W.H. (2023) 'A method for calculating the external costs of farm animal welfare based on the Welfare Quality[®] Protocol'. Available at: <https://doi.org/10.3389/fanim.2023.1195221>.

Mills, A. (2014) 'Health Care Systems in Low- and Middle-Income Countries _ Enhanced Reader.pdf', *New England Journal of Medicine*, February 6.

Reick, B. *et al.* (2021) 'Influence of Charging Losses on Energy Consumption and CO2 Emissions of Battery-Electric Vehicles', *Vehicles*, 3(4), pp. 736–748. Available at: <https://doi.org/10.3390/vehicles3040043>.

Stern (2022) *Capital expenditures by Industry, Capital expenditures by sector*. Available at: https://pages.stern.nyu.edu/~adamodar/New_Home_Page/datafile/capex.html (Accessed: 7 November 2022).