Received: 28 July 2022 | Revised: 15 February 2023 | Accepted: 21 February 2023

DOI: 10.1002/bse.3400

RESEARCH ARTICLE

Business Strategy and the Environment

WILEY

Piloting Oiconomy Pricing: First experiences of producers applying full cost sustainability assessment of products

Walter J. V. Vermeulen | Pim R. Croes | Larissa van der Feen

Copernicus Institute of Sustainable Development, Utrecht University, Utrecht, The Netherlands

Correspondence
Walter J.V. Vermeulen, Copernicus Institute of Sustainable Development, Utrecht University, PO Box 80115, 3508 TC Utrecht, The Netherlands.
Email: w.j.v.vermeulen@uu.nl

Funding information
The authors disclosed receipt of the following financial support for the research, authorship and/or publication of this article. This project has received funding from the Rijksdienst voor Ondernemend Nederland, Fonds Bestrijding Kinderarbeid, Agreement no. 202109132.

Abstract

The Oiconomy Pricing approach provides an innovative way of measuring and communicating (un)sustainability of products. It expresses (un)sustainability in a virtual monetary unit, the 'Eco Social Cost Unit' (ESCU). As closely as possible, the ESCU score of a product equals the externalities, which can also be described as hidden preventative costs. In the context of product sustainability assessment, these are the costs that need to be spent to avoid any damage to the environment or society that the product causes during its entire lifecycle. This paper presents the result of a pilot project with three companies operating in global value chains, applying the Oiconomy Sustainability Assessment Tool. The project encouraged end-producer companies and their value chain partners to calculate the hidden preventative costs and jointly implement sustainable solutions. This article presents the results of these calculations for the three cases, the experiences of the companies and the implications for the market introduction of the tool.

KEYWORDS
corporate sustainability, full cost accounting, life cycle assessment, monetary valuation, performance measurement, sustainable value chain management

1 | INTRODUCTION: EMERGENCY OF FULL COSTS ACCOUNTING OF PRODUCTS

Corporate sustainability (CS), also described as corporate social responsibility (CSR), presents the role of business in contributing to addressing the current massive sustainability challenges in its full complexity. This complexity is illustrated by the 17 Sustainable Development Goals (SDGs) (and 169 subgoals) agreed upon in the United Nations. It includes a twin agenda of integral environmental and societal fairness: the triple-P agenda (Planet, People and Prosperity) (Vermeulen, 2018). The World Business Council for Sustainable Development (WBCSD) argues that this critical agenda cannot be realized without effective engagement by the private sector. As a crucial element of their programmes for business engagement, they state that 'better information equals better decision-making; disclosing sustainability risks and impacts, and pricing them appropriately, is increasingly where the market is heading for' (WBCSD, 2022).

However, the practice of CS performance measurement rather looks like the Babylonian confusion of speech. First problem is that many competing measurement tools exist, mostly addressing only a few

Abbreviations: ADMC, is company name; CBA, Cost-benefit analysis; CS, Corporate sustainability; CSR, Corporate social responsibility; EPS, Environmental Priority Strategies; ESCU(s), Eco Social Cost Unit(s); EVR, Environmental-Costs/Value-Ratio; FAO, Food and Agriculture Organisation; ILO, International Labour Organisation; ISO, International Organization for Standardization; LCA, Life cycle assessment; LCSA, Life cycle sustainability assessment; NGO's, Non-governmental organsations; OECD, Organisation for Economic Co-operation and Development; PPP, Planet, People, Prosperity; RVO, Netherlands Enterprise Agency (Rijksdienst voor Ondernemend Nederland); SDG(s), Sustainable Development Goal (s); SME(s), Small and medium sized enterprise(s); UN, United Nations; WBCSD, World Business Council for Sustainable Development.

or one of the 17 SDGs, not integrating the environmental and social dimensions. The academic community has produced many approaches, but there is little collaboration and work toward the integration of approaches (Heijungs et al., 2010; Morioka & de Carvalho, 2016; Vermeulen, 2015). Second, these tools focus on measuring the negative impacts produced, thus not showing companies what they could or should do but rather showing their negative external impacts to be addressed (Vermeulen & Witjes, 2016; Witjes et al., 2018).

Third, these assessment tools are often based on general available data on production activities and their negative impacts for product categories, provided by tools and repositories, using (national) data, but almost always based on one or few specific cases. Most supply chains remain uninvestigated, and therefore, a life cycle assessment (LCA) often remains generic instead of specific (Thies et al., 2019; Visentin et al., 2020).

The Oiconomy Pricing system provides a methodology to assess any specific supply chain. At first use, still generic averages can be used (Croes & Vermeulen, 2015). In many LCA studies, users collect background data related to the product, but the Oiconomy Pricing system is a bookkeeping system intended to be yearly executed and intended to gradually grow to complete foreground assessments by the supply chain partners jointly. Additionally, the Oiconomy Pricing system does not use data on negative impacts but on the quantity of materials and activities that cause impacts, using a range of databases, like from the World Bank, ILO, FAO and the EcoCost system (which data are derived from LCA tools and databases like Ecoinvent, Gabi and Simpapro).

As a solution for the need to map one's specific value chain performances, the Oiconomy Pricing methodology was developed. It presents a practical tool for companies, which enables them to make a full triple-P spectrum assessment together with their main suppliers. It is expressed in the standard monetary language in the market, with a focus on solutions (prevention and abatement options) rather than on negative impacts on nature and society. Various forms of monetarization approaches in environmental impact assessment do exist for some time (Ahlroth, 2014). It roots in cost–benefit analysis (CBA) of public and private projects with economic, environmental and social impacts. In this context, economic benefits are weighed against the cost of the environmental and social impacts of proposed projects (Weidema et al., 2013). In a review, Pizzol et al. (2015) assessed the applicability of various existing methods for establishing cost factors (including 'observed preferences'; 'revealed preferences'; 'stated preferences', 'budget constraints' and 'abatement costs') in the context of LCA. They conclude that not one method is generally recommendable for LCA, but rather a careful combination of methods is required. However, they did identify and recommend valuation methods for each separate LCA impact category. This context and topic-specific tailoring has serious drawbacks. The results of these impact-oriented cost assessments vary strongly depending on the selected method, as is also shown in their analysis (Pizzol et al., 2015, p. 177). The same wide methodological divergence can be observed in the ISO 14008:2019 standard for monetary valuation of environmental impacts and related environmental aspects (International Organization for Standardization [ISO], 2019), which describes rules for the proper use of a similar set of 'revealed' and 'stated preference' methods, as well as 'market prices proxies', focusing mostly on describing environmental impacts. These methods have various limitations, being based on the subjective preferences of individuals in specific socio-economic contexts or market data or even hypothetical market responses in specific socio-economic contexts.

In contrast to the early application of CBA, monetarization is relatively new in the field of product assessment, partly borrowing from the field of environmental impact assessment and CBA. A recent review shows a strong role for consulting intermediaries in the market, providing such product assessments disclosing the 'full price', 'hidden price', 'true value', 'fair price' or 'true costs' of products by assessing the value of the environmental and/or social impacts created in the production and/or use of the products (de Adelhart Toorop et al., 2021). They observe various challenges for this field of research, including the level of integration of sustainability aspects, how and which costs can be aggregated and how one should deal with expressing negative externalities versus positive externalities of products. This review does not provide insights into the specific calculation rules and theoretical foundations of the approaches discussed. Comparable challenges have been observed for Life Cycle Sustainability Assessment (LCSA), which most often is seen as the sum of LCA, life cycle costing and social LCA (Costa et al., 2019).

Comparable observations have been made in two other recent review studies. Arendt et al. () compare the results of different monetization methods specifically designed to be used in LCA modelling (Ecovalue12, Stepwise2006, LIME3, Ecotax, Vogtländer's Environmental-Costs/Value-Ratio (EVR), Environmental Priority Strategies (EPS), the Environmental Prices Handbook, Trucost and the Environmental Material Performance of Building Elements [known as MMG-Method]). Using several axes of analyses, they find that most methods use the damage costs as their cost perspective, whereas the EVR uses abatement costs and Ecotax uses societies' willingness to pay (Arendt et al., 2020). The authors describe how the discrepancies between the monetary valuation approaches require careful attention from practitioners and method developers. The methods' resulting monetary values obtained when applying them in LCA studies can vary significantly according to the choice of approach. The review also observes a lack of consensus on how to categorize the various impacts and where to limit the scope of the impact pathway.

Amadei et al. (2021) build on these articles and study practical challenges related to the application of monetary valuation in LCA. They find great variability in the availability of monetary valuation coefficients across impact categories, with some (e.g., climate change, ozone depletion and acidification) commonly analysed, compared with others (e.g., terrestrial eutrophication) with very little information available to date. Additionally, the authors note that exhaustive and complete information detailing the underpinning methodology applied for deriving the monetization coefficients is not always available.

Another recent review of approaches for the integration of the three sustainability domains (environmental, economic and social) also included some monetarization approaches, with the 'True Value Methodology' of KPMG as an example (Huysveld et al., 2021). This

review especially focused on integration within the three sustainability domains and across these domains, as well as effective form of communicating aggregated results. It discusses various challenges of monetarization, but mainly from the perspective of using this as a weighing approach in LCA and LCSA. It does not include an assessment of prevention or abatement cost approaches. In their view, the monetarization approach is one of the less useful approaches. This review is interesting in its attention for the aggregation of negative and positive impacts and its reflections on the differences between strong and weak sustainability, which is not addressed in the above reviews.

We observe that most available approaches focus on valuating the negative environmental impacts, while some include some social impacts. The Oiconomy Pricing approach integrates all sustainability aspects. It presents a transparent, science-based approach and a focus on prevention instead of damage costs, which is unique in the world, as well as the feature that lets companies apply the methodology themselves and can integrate it in their supplier base information systems. It takes the economic concept of externalities as the departure point for the assessment. In economics, an externality or external cost is an indirect cost or benefit to an uninvolved third actor that arises as an effect or impact of the first actor's activity (Benoît Norris et al., 2009, p. 16; Goodstein, 2014, p. 32; Gruber, 2018). Oiconomy Pricing determines the costs of preventing negative externalities (not the costs of the negative impacts themselves) and the positive externalities themselves as benefits (Croes & Vermeulen, 2021).

The Oiconomy Pricing methodology has been developed since 2015 in various publications and recently in the form of an assessment tool that can be applied by companies and their main suppliers themselves. Initial research focused on positioning the core idea of the approach in the existing field of LCA and sustainability performance measurement (Croes, 2021; Croes & Vermeulen, 2016a), justifying the methodological ground rules. The methodology first collects foreground performance data on all sustainability aspects. The performance data are translated into preventative costs. These are specific foreground data if the company can provide a cost calculation for the prevention of specific issues. If the company cannot provide this, the method provides default preventative costs. The methodology for establishing these default values was elaborated with state-of-the-art reviews and checks on data quality of existing global databases for examples of social impact indicators, including fair wages, levels of inequality and corruption prevention (Croes & Vermeulen, 2016a, 2016b, 2019). There are two forces in the system to challenge users to increase the development of and the use of foreground data: first, the background 'Eco Social Cost Unit' (ESCU) is based on marginal preventative costs and worst cases, which are usually higher than foreground ESCUs (like explained in Croes & Vermeulen, 2015); second, fully foreground ESCUs are equal to the real extra costs (without margins) for the sustainable version of the specific product and end-producers who apply Oiconomy Pricing are likely to push their suppliers to provide these data, as these show better which efforts to improve have been taken in the value chain.

The methodology finally also includes a systematic analysis of methods used for including positive impacts in the methodology, preventing forms of greenwashing (Laufer, 2003; Ramus & Montiel, 2005; Seele & Gatti, 2017). It applies our proposal for strict rules on what is acceptable as 'positive externality', by excluding positive impacts (like the health impacts of medicine) represented in the transaction prices; see, for more detail, Croes and Vermeulen (2021).

2 | METHODS

This paper presents the experiences of three companies applying the Oiconomy Pricing Assessment Tool. The objective of the pilot study was to test whether the method was clear enough to be applied by company experts themselves instead of external consultants, to identify points of improvement before further market introduction and to share experiences with forms of presentation of the outcomes in the supplier–customer communications and evoke collaboration about further performance improvement. We first briefly discuss the method of Oiconomy Pricing and next the method of the pilot study.

2.1 | Oiconomy Pricing: Design and principles

The negative hidden costs measured in Oiconomy Pricing are covering all impacts issues the production and use phase related to the 17 UN SDGs, or in other words: triple-P pillars (Planet, People and Prosperity) of sustainability. Table 1 displays the included aspects in measuring the preventative costs toward a fully sustainable product. In contrast to many environmental assessment methods, Oiconomy Pricing addresses all SDG-related sustainability aspects with a consistent and comprehensive methodology. It enables fully integrated assessment and prevents (unintended) trade-offs between sustainability aspects (Barbier & Burgess, 2019; Biggeri et al., 2019). All preventative costs are expressed in a virtual monetary unit, the 'Eco Social Cost Unit' (ESCU). This represents the costs that should have been made to avoid any of the damage that the product causes during its entire lifecycle and can be expressed in any currency.

Besides negative hidden costs, related to negative externalities, positive externalities occur when a third actor benefits from activities or consumption of a product without contributing to the (full) costs of the transaction (Benoît Norris et al., 2009). Croes and Vermeulen (2021) formulated a list of criteria for the allocation of positive costs.

With its focus on preventative costs (also referred to as 'mitigation', 'avoidance' or 'abatement' costs in literature), Oiconomy Pricing is fundamentally different from the approaches referred to in the introduction. The rationale for this is that by presenting sustainability performance in terms of costs for prevention, translated to the price per product, it informs the key actors inside the company in the same language needed for strategy development and in supplier collaboration: aspects to be improved and their expected costs (Vermeulen & Witjes, 2016). In essence, additional costs needed for performance improvement will ultimately have to be integrated in the prices of transactions between buyers and suppliers in the value chain, finally resulting in a probably higher sales price, but without the hidden costs for others in society and nature. The lower the hidden costs are, the closer the product is to being fully sustainable. Initially however, the

TABLE 1 Included aspects Oiconomy Pricing.

Pillar	Aspect categories	Measures preventative costs towards:
Planet	Pollutant emissions	Zero emissions of harmful gases/ substances to air, soil and water (climate, bulk gases, toxic emissions and agrichemicals)
	Use of scarce resources	Use of renewable or recycled resources instead of non-renewable or virgin resources (incl. water)
	Biodiversity	Preservation of (original) biodiversity
	Land use	Optimizing yields for food production
	Waste & Disposal	Sustainable disposal of waste and optimized lifetime of product
People	Human health risk	Reduced human health risks
	Labour	Fair remuneration and safe labour conditions
		Fair inequality between lowest and highest salary within company
		Sufficient contribution to health insurance, personal development and pension plans
		Ensuring occupational health and safety
		Mitigation of child labour.
Prosperity	Economic Responsibility	Fair payment to suppliers
		Responsible financial management
		Fair tax behaviour
	Corruption & Conflict	Prevention of corruption and conflict

purpose is rather to use the information internally in supply chain collaboration on improvement, rather than in consumer-oriented communications.

The system copies the normal economic price build-up in the supply chain for the hidden costs of preventing environmental, social and economic harm, inflicted as consequence of the production, use and disposal of the product. The actors themselves make the assessments and calculations and transfer the results to the next in the supply chain. When self-administered ('foreground') data are not available, the system provides default ('background') data. There are two types of data used in the system: (1) performance data and (2) data on preventative costs. Performance data are data measuring the sustainability performance of companies (e.g., kWh used, wages paid, emissions and safety incidents occurring). Performance data should be foreground data as much as possible, as this reflects the reality of activities in the supply chain. The system distinguishes the foreground data on emissions from power suppliers; background data are available in the system based on the average mix of energy carriers' country.

Data on preventative costs reflect data on the cost of sustainability mitigation measures (e.g., investing in solar panels, paying fair minimum wages and implementing safety measures). It is preferable to use company-specific preventative costs; however, this takes time as companies need to assess the costs of specific mitigation measures. If such data are not available, generic data-base sourced data on sustainability mitigation measures are used. For the environmental aspects, we use the EcoCost approach developed by Vogtländer (Vogtländer et al., 2001; Vogtländer & Bijma, 2000; Wever & Vogtländer, 2013), while for the people and prosperity aspects, we developed approach with the same line reasoning for determining default values for preventative costs.

Trustworthiness of the data is obtained by verification and certification according to international standards. A draft standard is available for certification purposes and an assessment tool for the actors in the supply chain.

The core design principles of Oiconomy Pricing are:

1. All triple-P pillars (Planet, People and Prosperity) are included, covering all 17 UN SDGs. The word 'sustainability' therefore includes social and economic responsibility.
2. (Un)sustainability is determined by the additional costs for a sustainable product version, expressed in ESCUs.
3. ESCUs are transferred as one total value and also separately for the 10 aspect categories.
4. Verification of the reliability of the data takes place by means of certification on the Oiconomy standard (in the future).
5. Information about the sustainability performance in the form of ESCUs is transferred and documented in the value chain like normal prices (without the margins). The Oiconomy System is a bookkeeping system for the yet hidden preventative externalities.
6. By only transferring information in the form of aggregated ESCUs, the intellectual property of production specifications of suppliers remains safe.
7. The Oiconomy system is a type of 'life cycle assessment', but applied by the value chain actors themselves, instead of afterward by scientists, consultants or NGOs, based on general databases.
8. Without demonstrable specific data, generic default values from a database are used, but the companies can continuously improve these with their specific data and investment calculations.

The method is available for all, presented in the form of an open science project. More detailed descriptions and justifications are available online (https://oiconomy.geo.uu.nl/justification/). The tool is ready for use and almost all-inclusive for the SDGs. It can still be further improved. Scholars are invited to critically review the approach and possibly suggest refinements.

2.2 | Pilot study

From November 2021 to March 2022, three pilot companies applied the Oiconomy Pricing, with one part-time researcher at our university

available for explanations and support. The governmental Netherlands Enterprise Agency (RVO) funded the pilot project and supported the selection of the case study participants. A more extended report is available (Vermeulen et al., 2022). The end-producers (one selling spices to consumers, one producing stone kitchen topping and one producing medical devices) involved their main suppliers to measure their hidden costs.

Figure 1 displays the process of calculating hidden costs through the Oiconomy Sustainability Assessment Tool. The first step in applying the assessment is scoping the supply chain. The practitioner needs to identify suppliers that are within 80% of the purchased value of a product. In addition to the 80%, all inputs with high impact are added. The suppliers that fall within the 80% scope need to be included in the Oiconomy Pricing Assessment. The tool then challenges these selected companies to self-provide their specific ('foreground') costs to prevent causing harm or in other words, the extra costs (without margin) for the sustainable version of the product. However, in the absence of foreground preventative costs, the tool provides default ('background') data, which are based on either internationally determined conventions, science or benchmarks. Many of the details of the method are described in the published articles (Croes, 2021; Croes & Vermeulen, 2015, 2016a, 2016b, 2019, 2020, 2021). In addition, a science document with an explanation and justification is available online (see Section 2.1).

In the results, we will describe the main results of the self-assessment, the experiences of the pilot companies using the tool and engaging in supplier collaboration and their ability to use foreground data.

3 | CASE STUDY RESULTS

3.1 | Case study 1: Stone kitchen countertop

The first pilot case is *Arte*, a company producing stone kitchen counter topping. The company is located in the Netherlands and produces various types of stone kitchen counter tops. The unit under review is 1 m^2 of stone kitchen countertop, and the exact product properties are not disclosed due to the confidentiality of supply-chain partners. The supply chain of the stone countertop was traced back by including 80% of the purchased value. This identified the most relevant supply chains for stone: feldspar, clay and other chemicals (Figure 2). The stone surfaces manufacturer and Arte supplied foreground data, and the clay, feldspar and chemical suppliers were assessed using background data from databases. The results reveal that the total hidden cost of 1 m^2 of stone countertop is €32.44 (Figure 3). The sales price of a 1 m^2 stone countertop is €912 meaning the hidden costs are adding 3.56% onto the sales price.

The main negative hidden costs come from the category Pollution & Climate. Pollution & Climate measures the cost to prevent polluting emissions to soil, air and water. Most of the costs are a result of the manufacturing process and transport of the stone surfaces producer (€5.15); other costs relate to the energy usage of Arte (€1.54) and the mining operations of clay and feldspar (€2.41 and €0.85). The second biggest category is Labour. Labour measures fair wages, fair inequality and other labour conditions. The bulk of the costs come from the stone surfaces manufacturer as they could not demonstrate the absence of various labour aspects.

There is a high risk of child labour in the feldspar and clay mines in Ukraine and Turkey. The lack of demonstrated evidence of the absence of child labour led to the allocation of €0.12. This is the amount necessary to replace the children with adults earning a fair minimum wage. In the category Waste & Disposal, the cost-distance to sustainable disposal is measured for both processing waste and end-of-life waste. Negative costs emerge from the end-of-life disposal as the demolition of the countertop creates inert waste (€4.20). Furthermore, hidden costs found include costs of preventing the depletion of scarce resources. The stone surfaces manufacturer uses a lot of fossil resources, which lead to negative costs of €1.33. Additionally, the water consumption for 1 m^2 of countertop is 0.17 m^3 and is extracted in a water-scarce area, which leads to negative hidden costs of €3.09.

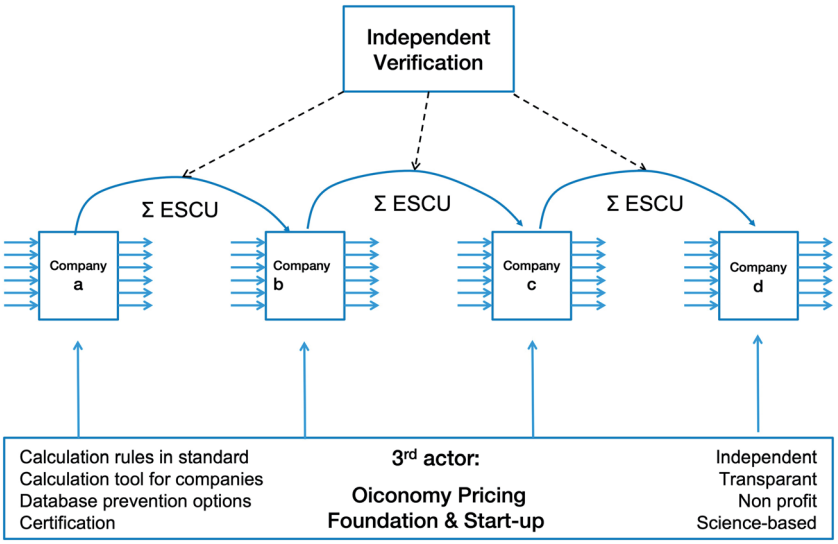
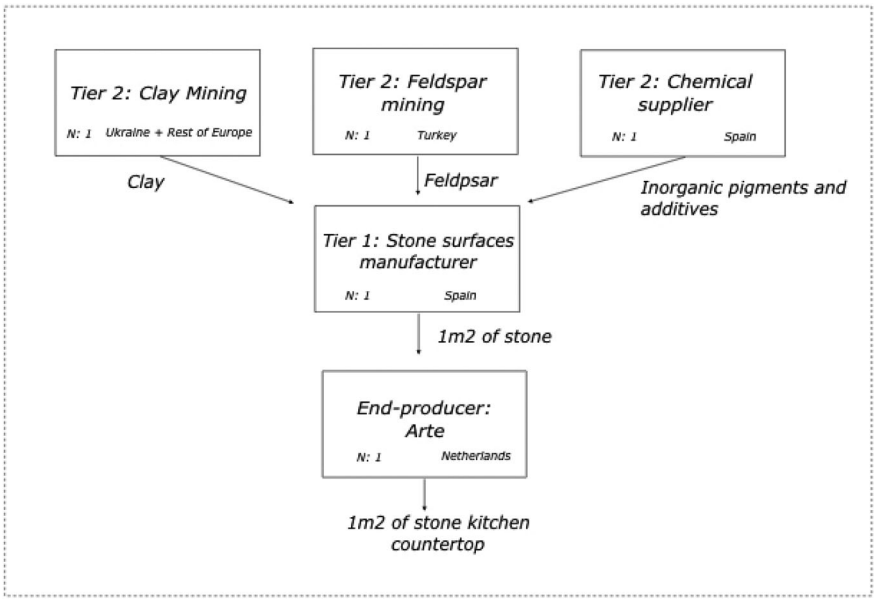


FIGURE 1 Oiconomy Pricing Assessment Tool.

FIGURE 2 Scope of assessment.



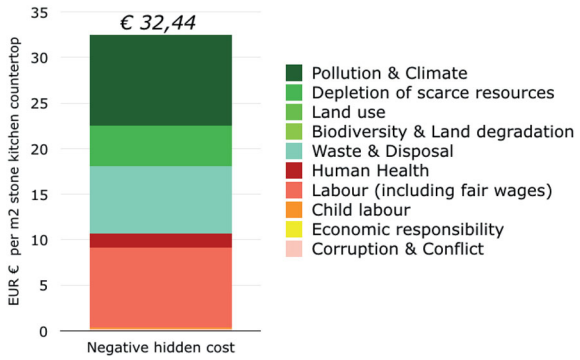


FIGURE 3 Breakdown negative hidden costs.

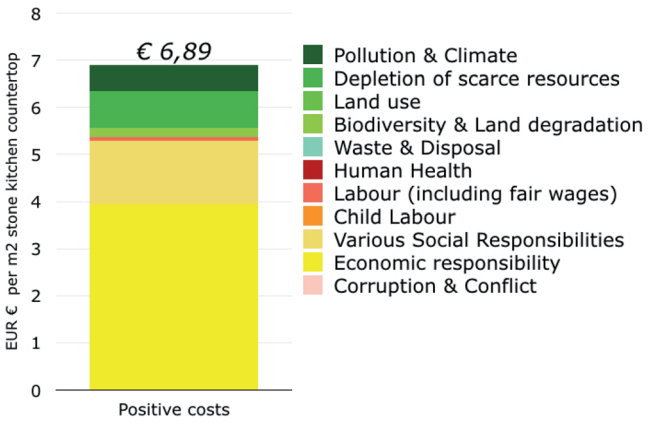


FIGURE 4 Breakdown of positive costs per m^2 stone countertop.

Besides negative hidden costs, positive costs were calculated (Figure 4). Positive costs of €6.89 were found, which were spent by Arte and by the stone surfaces manufacturer. Among other things, Arte invested in extra preventative medical care for their employees (category: Social Responsibility) and set up the Responsible Stone Foundation that aims to eradicate child labour in the communities nearby stone quarries by supporting quality education (category: Economic Responsibility).

More details of this case study are available (van den Beucken et al., 2022).

3.1.1 | Data specificity assessment of m^2 stone kitchen countertop

Performance data are data measuring the sustainability performance of companies (e.g., kWh used). The data specificity of performance data of this analysis is displayed in Figure 5. Arte was able to complete the assessment using mainly company-specific data. The stone

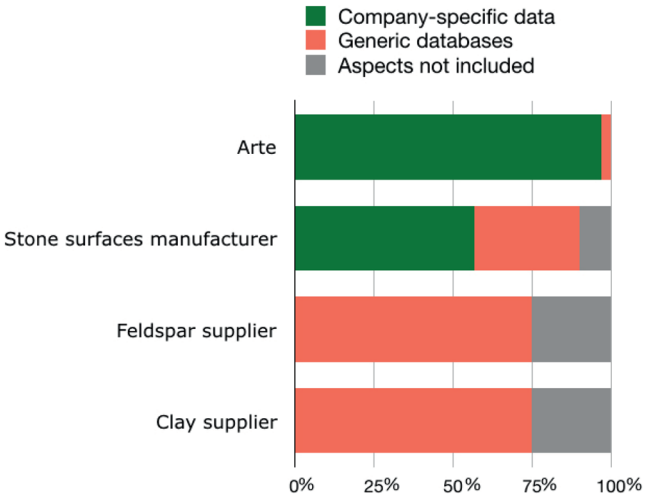


FIGURE 5 Data specificity of performance costs (green = foreground data, red = background data, grey = no data available).

surfaces manufacturer also actively took part in this pilot but was not able to demonstrate all the data, so partly, background data was used. Regarding the feldspar and clay supplier, only background data were used.

Preventative costs are data on the costs of sustainability mitigation measures (e.g., investing in solar panels). The data specificity of preventative costs of this analysis is displayed in Figure 6. None of the value-chain partners were able to provide much foreground preventative costs, as it takes time to make investment proposals to mitigate impact. This should be a focus when the assessment is repeated.

3.2 | Case study 2: Medical device

The second pilot company is *ADMC Group*, located in the Netherlands. ADMC produces medical equipment in the rehabilitation and physiotherapy field. The product under review is a pack heater. The pack heater is an electrical box that can heat packs used in heat therapy. The supply chain of the pack heater was traced back by including 80% of the purchased value. This includes the most relevant supply-chain actors: the steel components (outer body of the pack heater, inner body, the net, the cover and the handle) (Figure 7). ADMC and the steel workshops were able to provide data on their sustainability performance, and data from the steel producer and steel trader were sourced using databases. The total hidden cost of a pack heater is €130.12 (Figure 8). The sales price of a pack heater is €1600, meaning the hidden costs are adding 8.13% onto the sales price.

The main negative hidden costs come from the category Labour. Labour measures fair wages, fair inequality and other labour conditions. The main costs come from the steel workshops as employees receive a remuneration that is far below the fair minimum wage as set by Oiconomy Pricing in Croes and Vermeulen (2016b). Employees in the workshops earn €55–65 per month, while the fair minimum wage

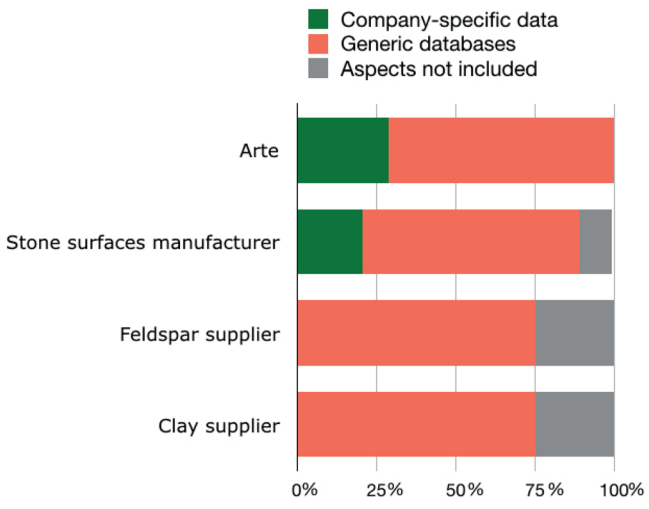


FIGURE 6 Data specificity of preventative costs (green = foreground data, red = background data, grey = no data available).

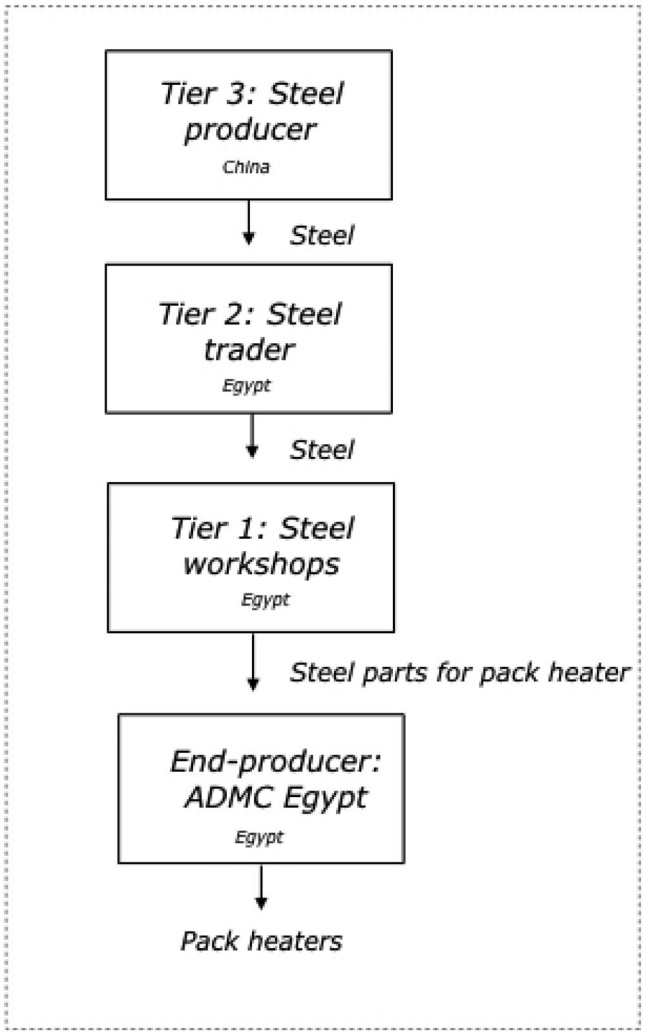


FIGURE 7 Scope of assessment.

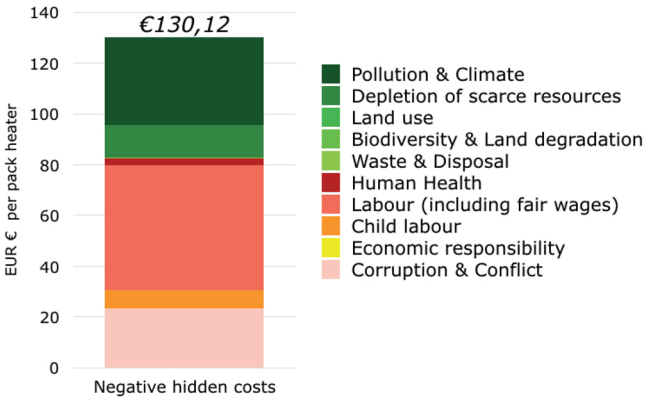


FIGURE 8 Breakdown negative hidden costs.

is €129 per month. Increasing the price of the product, so employees receive a fair minimum wage leads to negative costs of €24.88. Besides fair remuneration, the employees do not receive a sufficient contribution to health insurance nor is their occupational health and safety sufficiently managed (€3.69). Besides the steel workshops, steel

traders were allocated default costs on Labour, as no company-specific data were gathered (€9.46). Gathering specific data on the steel trader or cutting out this middleman could eliminate these costs. The second biggest impact category is Pollution & Climate. The electricity consumed by the steel workshops (€12.12), ADMC (€9.00) and CO_2 emissions during steel production (€11.42) contribute mostly to this. The negative costs on depletion of scarce resources are background costs for the primary production of steel in China (€11.42).

Besides negative hidden costs, positive costs were calculated (Figure 9). Positive costs of €17.56 were found, and all of this was spent by ADMC. ADMC invested to train their employees, reimburse medical expenses and contribute to a project to prevent child labour, by among other things providing microcredits and by organizing capacity-raising activities.

More details of this case study are available (Benjamin et al., 2022).

3.2.1 | Data specificity assessment of pack heater

The data specificity of the performance data of this assessment is displayed in Figure 10. ADMC Group was able to complete the assessment using mainly company-specific data. Data on the steel workshops was retrieved through a questionnaire conducted by a local NGO. Regarding the steel trader and steel producer, data was mostly obtained using generic databases.

The data specificity of preventative costs of this analysis is displayed in Figure 11. None of the value-chain partners were able to provide much company-specific preventative costs, as it takes time to make investment proposals to mitigate the impact. This should be a focus when the assessment is repeated.

3.3 | Case study 3: White pepper

The third pilot company is *Verstegen Spices & Sauces*, located in the Netherlands. The product under review was one jar of ground white pepper. Verstegen sells white pepper sourced from Indonesia, where

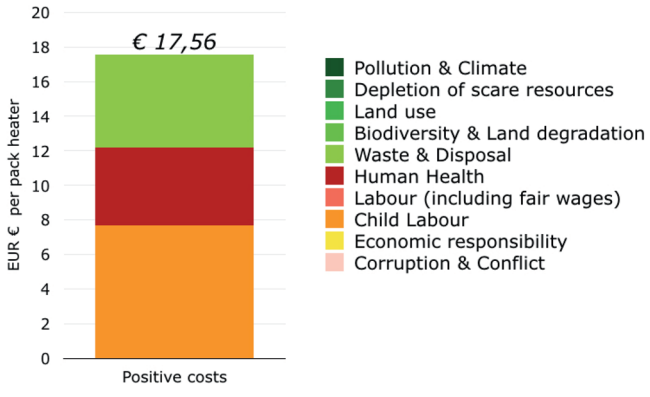


FIGURE 9 Positive costs per pack heater.

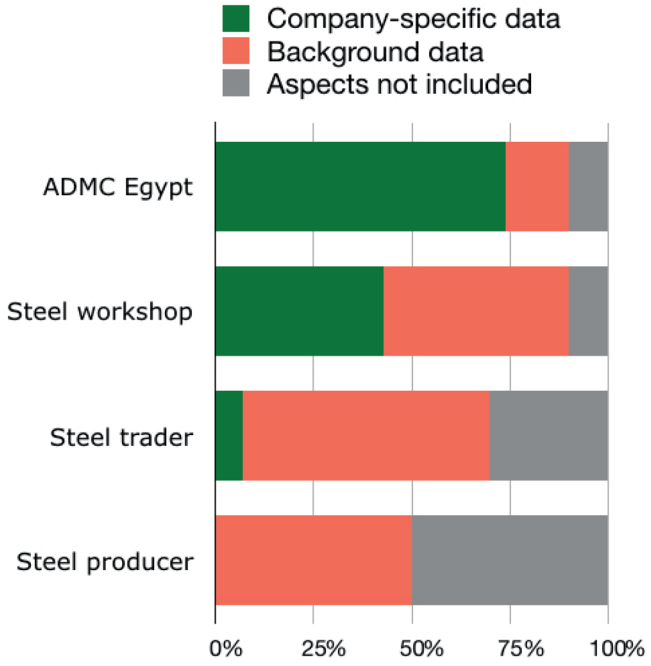


FIGURE 10 Data specificity of performance costs (green = foreground data, red = background data, grey = no data available).

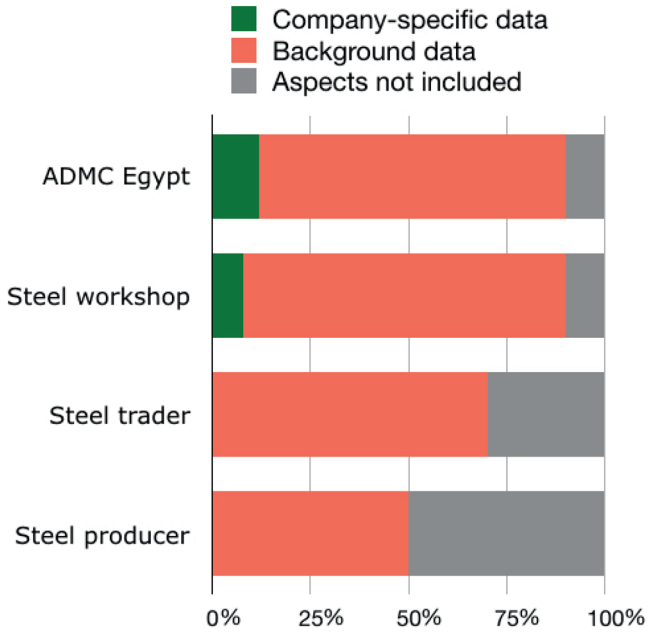


FIGURE 11 Data specificity of preventative costs (green = foreground data, red = background data, grey= no data available).

the pepper is cultivated by smallholders and sold to the pepper exporter. The supply chain of white pepper in a jar was traced back by including 80% of the purchased value. This identified the most relevant supply chains: the plastic cap, the white pepper and the glass jar (Figure 12). The total hidden costs of one jar of grinded white pepper

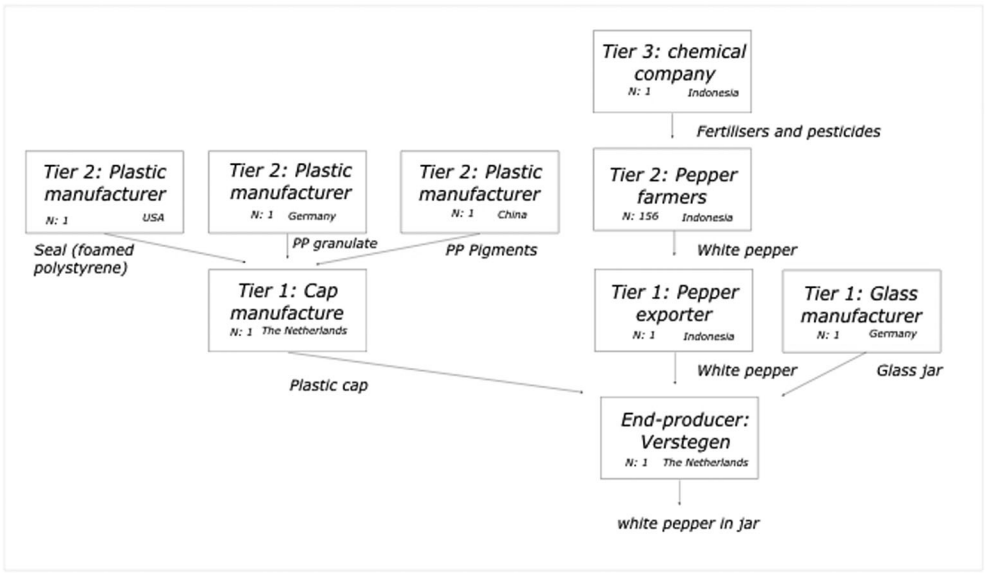


FIGURE 12 Scope of assessment.

are €1.03 (Figure 13). The sales price of a jar is €2.99 meaning the hidden costs are adding 34% onto the sales price.

The main negative hidden costs come from the category Labour. Labour measures fair wages, fair inequality and other labour conditions. The glass manufacturer has a salary inequality ratio of 98.7 between the lowest and highest paid salaries within the company. This is above the fair inequality ratio of 23.8 (Croes & Vermeulen, 2016b). This leads to costs of €0.76. Additionally, the pepper farmers do not offer their employees' health insurance or ensure occupational health and safety (€0.04). The second and third biggest cost categories are Pollution & Climate and Corruption & Conflict. Most costs to mitigate pollution are caused by the pepper farmers using fertilizers (€0.01) and through the production of glass (€0.19). Pepper farmers and pepper exporters are most susceptible to corruption and have no active governance to mitigate that (€0.04). Other hidden costs that were found include costs to prevent biodiversity loss. Verstegen, together with the pepper exporter, invested in agroforestry solutions to increase biodiversity. Through this project, supply-chain-specific mitigation costs were used to calculate preventative costs.

Besides negative hidden costs, positive costs were calculated (Figure 14). Positive costs are based on actual company spending, benefitting others than the ones involved in the transaction. Positive costs of €0.89 were found; 98% of this was spent by Verstegen. Verstegen invested to increase yields, contributing to food security (expressed in the category Land use). The project also led to increased livelihoods of pepper farmers (Economic Responsibility).

More details of this case study are available (Verschuren et al., 2022).

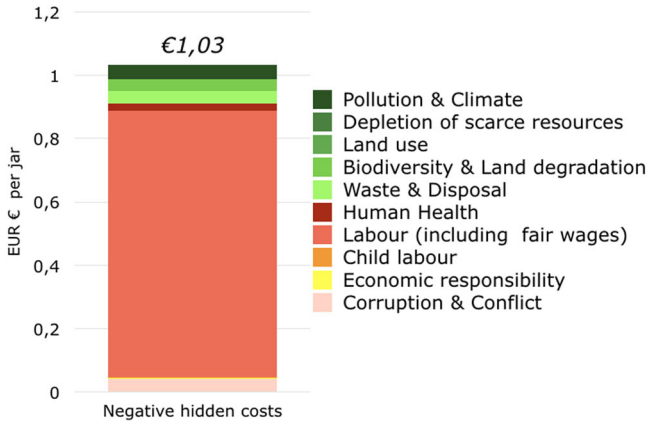


FIGURE 13 Breakdown negative hidden costs.

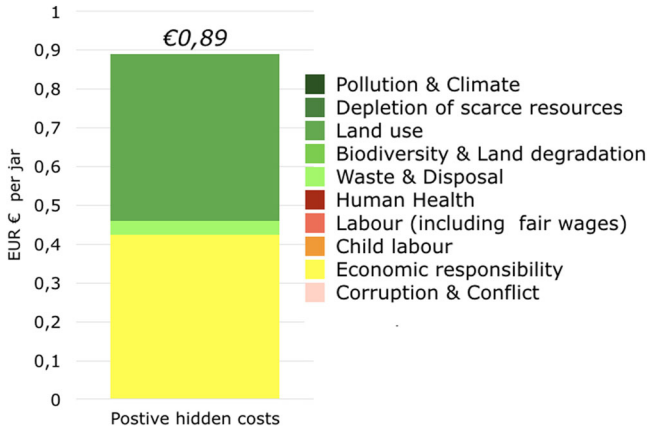


FIGURE 14 Positive costs per jar of white pepper.

3.3.1 | Data specificity assessment of white pepper

The data specificity of performance data of this analysis is displayed in Figure 15. Verstegen, the pepper exporter, the pepper farmers and the cap manufacturer were able to complete the assessment using mainly company-specific data. The data of the glass manufacturer was mainly obtained through generic databases.

The data specificity of prevention data is displayed in Figure 16. None of the value-chain partners were able to provide much company-specific preventative costs, as it takes time to make investment proposals to mitigate impact. This should be a focus when the assessment is repeated.

4 | MAIN OBSERVATIONS AND LEARNINGS FROM CASE STUDIES

The case studies have resulted in observations and learnings that have implications on the Oiconomy Sustainability Assessment Tool, further

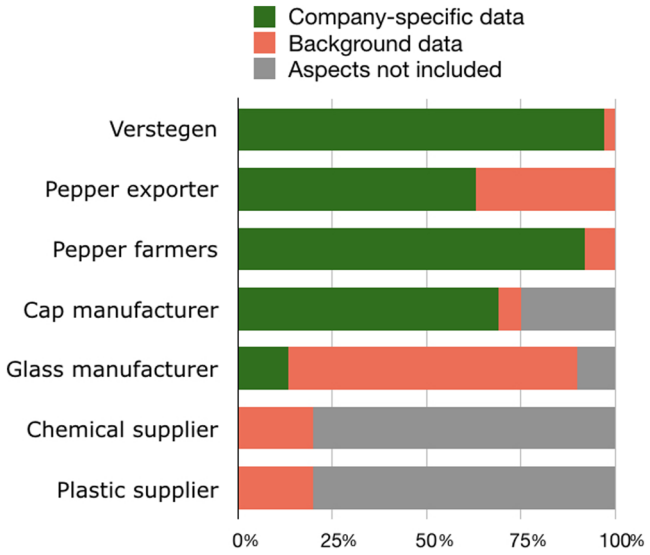


FIGURE 15 Data specificity of performance costs (green = foreground data, red = background data, grey = no data available).

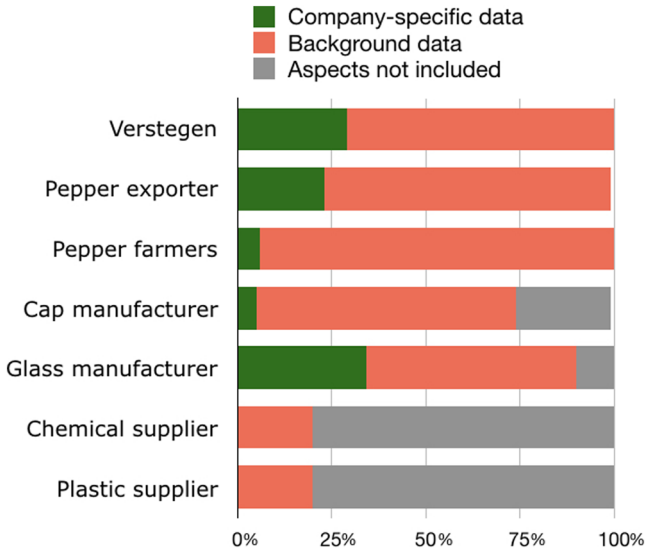


FIGURE 16 Data specificity of preventative costs (green = foreground data, red = background data, grey= no data available).

support that is necessary and on further development of the Oiconomy Pricing methodology.

Before the start of the pilot, the participating companies were informed about the nature of the method and the intentions of the pilot. Support by the Oiconomy team was given in applying the calculation tool. With this support, they were able to finalize the assessment. The pilot project took 4 instead of the expected 3 months, in times of COVID-19, with only online communications. The time invested per company, including the support by the Oiconomy team, was around 5 weeks (200 h), of which approximately 60 h was the time spent by the company itself, but not including time spent by suppliers. One should note that future repetitions with experience would require far less time. The companies appreciated the inclusive nature and the use of the tool in the interactions with their main suppliers (Figures 17 and 18).

Being a pilot project, it was clear that explanation and instruction materials are still in development. However, with the support provided, the key principles of the approach were seen as useful, and the companies are considering further uptake of this approach. All three companies indicated that they will further apply the approach to other products and places, while one decided to integrate the approach into their sustainability strategy and supplier collaborations.

The following observations were made by the authors, including the implications for future application:

1. All pilot companies independently reached out to their main suppliers after the initial scoping of the assessment. With the background support from the university team, all three companies were able to complete the full-scope assessment. They found Oiconomy Pricing to be useful for starting the dialogue with suppliers, increasing transparency and jointly working toward a more sustainable product. The participating companies also appreciated the insights that the produced overview of the hidden costs provided them, as it gives them with a tool to measure the progress towards their sustainability goals. Also, using Oiconomy Pricing revealed hidden costs on various sustainability aspects that these companies were previously unaware of, like inequality or corruption. Overall, the pilot companies found Oiconomy Pricing to be a useful tool in navigating the complex field of sustainability.
2. The pilot companies were in good contact with their main suppliers and were able to convince and motivate the most relevant suppliers to join the pilot. Large suppliers of small elements of the product were hard to convince. In these cases, background-data-based assessments were made. In the future, users will need to be supported in filling such gaps.
3. For various aspects, the method includes a self-assessment of the quality of corporate governance, based on the worldwide applied form of management systems, applying the plan-do-check-act approach. The tool includes questionnaires that have been experienced as too detailed, especially in the case of small- and medium-size enterprises. The rationale for using this needs to be better communicated to users, while a simplified version is needed for SMEs.

FIGURE 17 Pilot study experiences: starting and motivation to use tool (−2 = very negative/2 = very positive) (average score of three companies).

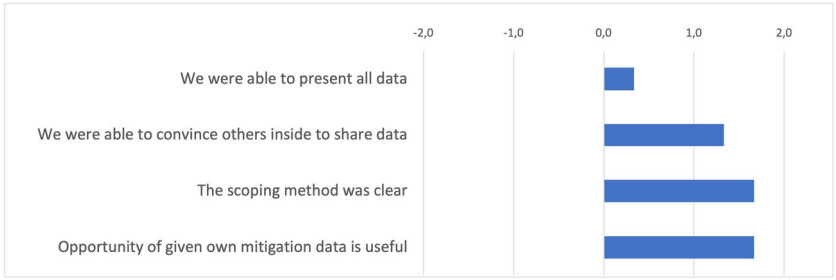


FIGURE 18 Pilot study experiences: working with the tool (−2 = very negative/2 = very positive) (average score of three companies).

4. It may be tempting to calculate the net positive value by distracting the negative costs from the positives, but this is not the intention of the system. The negative hidden costs are derived from the prevention of hidden negative impacts, and the positive costs are extra benefits for people and the planet, not included in the transaction costs. In our view, positive costs cannot compensate the negative costs (Croes & Vermeulen, 2021); if done so, it would be a form of greenwashing (Parguel et al., 2011; Ramus & Montiel, 2005; Seele & Gatti, 2017). In our discussions with the pilot firms, we saw the temptation to do this. We must communicate the rationale for not doing this more explicitly.
5. Full scope assessment is quite labour intensive the first time, mainly because the companies lack data. Future assessments will therefore be much easier. Based on the pilot experiences a guidance for starting to use Oiconomy Pricing can be developed. Before starting an assessment, a *quick ex-ante check* on applicability and product scoping can be done. Training opportunities and materials, online available explanations and justifications will be provided in the next stages.
6. Where more remote tiers of suppliers (third tier, fourth tier, etc.) are involved, it is harder to achieve direct participation and collaboration. This is especially relevant when small or medium size enterprises are involved in the middle- or low-income countries. Maintaining the full PPP scope in these cases raises objections of two types: (a) the total contribution to the total ESCU of the end product will be marginal, and (b) these remote suppliers may have many other clients, not being interested in such assessments for only one client. Despite this *dilution effect* in a specific value chain, the total of small contributions may still be relevant for prevention. Yet, the fact that the first tier suppliers could be involved also raises the expectation that in the longer term, when the requirement to engage in the system reaches the third tier, fourth tier and so forth suppliers from several customers, these third and fourth tier suppliers can also be engaged. However, we plan to develop standard ESCU values for a short list (100–200) of inputs in the remote supplier tiers to solve this dilution issue. Most of the environmental default data on remote tier suppliers are already in the system. Scientific research can contribute to adding such socio-economic default values.
7. Partly overlapping with this issue is that in remote tiers of suppliers, tool users may need to collaborate with *small suppliers with low-level capacities*, not used to business administrations or even illiterate. One cannot expect such small suppliers to contribute to the assessment. We will clarify the role of the supplier tier that is closest to such low-developed suppliers, giving them the responsibility of applying the tool.
8. The presentation of the overall results shows *very different distributions of hidden costs* between the sustainability aspects. This expressed the tailor-made approach showing the specifics of the supply chains analysed. Some relatively high scores as well as very low scores surprised both the companies as well as the university team. The correctness of the calculations was checked. In some cases, the underlying background data will be re-evaluated. We observe that an interpretation protocol for reading the end results is needed. Relative high preventative costs do by principle not equal relative high priority. Each sustainability aspect, identified as having (some) hidden negative costs, will need to be addressed. Low costs prevention options may still very well have high impact in reducing emissions or unfair social conditions.

9. Current positives were sometimes calculated as the positives of the entire organization divided by the percentage of revenue of the product under review, while they were location specific. However, we aim to only measure the positives linked to specific product value chains. We will adjust the standard by distinguishing rules for value-chain-specific positives and organization-wide positives to the related products.

As a result of these experiences, the tool has been further refined in a next version, which is now available and used by other companies.

5 | CONCLUSION AND DISCUSSION

The goal of the pilot study has been to test whether the Oiconomy Sustainability Assessment Tool is clear enough to lead to calculations of hidden costs by company experts instead of external consultants, to identify points of improvement of the methodology and to test whether the method evokes collaboration about further sustainability performance improvement along the supply chain.

Applying Oiconomy Pricing, the negative and positive hidden costs of a stone kitchen countertop, a medical device and a jar of white pepper were successfully calculated. The analysis revealed preventative costs of €32.44 per m^2 stone kitchen countertop, €130.12 per pack heater and €1.03 per jar of white pepper. Expressed as additional costs compared with the consumer sales prices, these preventative costs were respectively 3.6%, 8.1% and 34%. Other studies have shown comparable shares of hidden costs (Amadei et al., 2021; Arendt et al., 2020), but these outcomes cannot be compared, as they refer to smaller selections of sustainability aspects, they apply a different approach (average EU consumer purchases) and mainly use damage-based cost sources.

By using the Oiconomy Sustainability Assessment Tool, the company experts were guided in making the assessment. However, still being in the pilot phase, they needed additional support from the university team. Based on the issues encountered, we have been able to improve the Oiconomy Sustainability Assessment Tool and have started producing training and instruction materials to raise capacity within organizations.

Also, several points of methodological improvement were identified: questionnaires to check the quality of corporate governance needed to be simplified for SMEs, the relationship between negative and positive costs needs to be clarified, and standard ESCUs need to be calculated for raw material producers far upstream in the supply chain.

The pilot reached its objective of increasing supply-chain collaboration to improve sustainability, as the end-producers all started dialogues with suppliers on how to lower their environmental and social burden. Additionally, Oiconomy Pricing was able to provide companies with a holistic sustainability assessment of their product, showing preventative costs for sustainability aspects that companies were previously not aware of.

Oiconomy Pricing is relevant as transparency, and due diligence are increasingly incorporated into corporate responsibility legislation in the European Union, as well as by the OECD (Enneking & Veldman, 2021). Non-financial disclosure is required for large groups of companies, especially in the international market. Full sustainability costs accounting tools can serve the implementation of this new legislation. In this context, Oiconomy Pricing can serve as a tool in sustainable public procurement policy, having suppliers substantiate their bids with the Oiconomy price. Due to its design as measuring the costs of preventing all negative impacts related to Planet, People and Prosperity, the level of ESCU can be seen as the 'distance-to-sustainability'. The analysis guides companies to map the issue for continuous improvement jointly with their own main suppliers.

By taking this innovative route with three main features: including all SDGs, the preventative cost focus and the design as self-assessment by market actors, it enables bridging some of the main challenges identified in the field of monetarization of environmental impacts (Amadei et al., 2021; Arendt et al., 2020; de Adelhart Toorop et al., 2021), referred to in the introduction. The first challenge was the question of whether and how such costs could be aggregated. In our view, aggregating costs of impacts, especially in the context of the wide variety of perceptions or based market proxies-based methods, is indeed problematic, but aggregating preventative costs attributed to the production of products is not problematic as it shows the activities needed to be addressed CS strategies. However, one needs to be aware that all cost sorts need to be addressed. The corporate strategy only determines which activity will be implemented and when.

The second challenge was the level of integration of sustainability aspects. We have demonstrated that by using a consistent and comprehensive approach, all aspects can be integrated, and it can open the eyes of participants to aspects previously unnoticed and which would not have been addressed when a materiality-based approach was chosen.

The third challenge mentioned was how one should deal with expressing negative externalities versus the positive effects of products. In our approach, we clearly separate them and have developed a set of rules based on the principle that 'positives externalities' included can never be part of what the original transaction of buying the products is valuing (Croes & Vermeulen, 2021). In addition, we reject netting of negative and positive externalities as it obscures the sustainable pathway to be followed by companies applying full cost sustainability performance measurement.

The Oiconomy Pricing method is to be introduced to the market while a community of practice is created, joining forces of both front-running market actors and knowledge institutes. The methodology is open for further detailing and refinement. Scholars worldwide are invited to join us in the open science effort (see https://oiconomy.geo.uu.nl).

ACKNOWLEDGMENTS

The authors of this article express their gratitude to the persons that have enabled this pilot study, including Sara Benjamin, Niels van den Beucken, Tarek Isak, Anne Kempers, Evert-Jan Verschuren and Marjolein Vink.

CONFLICT OF INTEREST

The authors of this article have no conflict of interest to declare.

ORCID

Walter J. V. Vermeulen https://orcid.org/0000-0002-5947-8688
Pim R. Croes https://orcid.org/0000-0002-2106-4893
Larissa van der Feen https://orcid.org/0000-0002-2131-1604

REFERENCES

Ahlroth, S. (2014). The use of valuation and weighting sets in environmental impact assessment. *Resources, Conservation and Recycling*, *85*, 34–41. https://doi.org/10.1016/j.resconrec.2013.11.012

Amadei, A. M., de Laurentiis, V., & Sala, S. (2021). A review of monetary valuation in life cycle assessment: State of the art and future needs. *Journal of Cleaner Production*, *329*(November), 129668. https://doi.org/10.1016/j.jclepro.2021.129668

Arendt, R., Bachmann, T. M., Motoshita, M., Bach, V., & Finkbeiner, M. (2020). Comparison of different monetization methods in LCA: A review. *Sustainability (Switzerland)*, *12*(24), 1, 10493–39. https://doi.org/10.3390/su122410493

Barbier, E. B., & Burgess, J. C. (2019). Sustainable development goal indicators: Analyzing trade-offs and complementarities. *World Development*, *122*, 295–305. https://doi.org/10.1016/j.worlddev.2019.05.026

Benjamin, S., Croes, P. R., Vermeulen, W. J. V., & van der Feen, L. (2022). *Oiconomy Pricing—Real price of a pack heater*. Utrecht University. https://doi.org/10.5281/zenodo.6597561

Benoît Norris, C., Mazijn, B., et al. (2009). UNEP guidelines for social life cycle assessment of products. In *UNEP/SETAC*. UNEP/Earthprint.

Biggeri, M., Clark, D. A., Ferrannini, A., & Mauro, V. (2019). Tracking the SDGs in an 'integrated' manner: A proposal for a new index to capture synergies and trade-offs between and within goals. *World Development*, *122*, 628–647. https://doi.org/10.1016/j.worlddev.2019.05.022

Costa, D., Quinteiro, P., & Dias, A. C. (2019). A systematic review of life cycle sustainability assessment: Current state, methodological challenges, and implementation issues. In *Science of the total environment* (Vol. 686) (pp. 774–787). Elsevier B.V. https://doi.org/10.1016/j.scitotenv.2019.05.435

Croes, P. R. (2021). *Comprehensive in-supply chain life cycle assessment of the preventative cost-based externalities of products. An assessment methodology as first step to a sustainable and responsible true price economy: "Oiconomy"*. Utrecht University.

Croes, P. R., & Vermeulen, W. J. V. (2015). Comprehensive life cycle assessment by transferring of preventative costs in the supply chain of products. A first draft of the Oiconomy system. *Journal of Cleaner Production*, *102*, 177–187. https://doi.org/10.1016/j.jclepro.2015.04.040

Croes, P. R., & Vermeulen, W. J. V. (2016a). 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), 349–362. https://doi.org/10.1007/s11367-015-1018-0

Croes, P. R., & Vermeulen, W. J. V. (2016b). In search of income reference points for SLCA using a country level sustainability benchmark (part 2): Fair minimum wage. A contribution to the Oiconomy project. *The International Journal of Life Cycle Assessment*, *21*(3), 363–377. https://doi.org/10.1007/s11367-015-1017-1

Croes, P. R., & Vermeulen, W. J. V. (2019). Quantification of corruption in preventative cost-based S-LCA: A contribution to the Oiconomy project. *The International Journal of Life Cycle Assessment*, *24*(1), 142–159. https://doi.org/10.1007/s11367-018-1507-z

Croes, P. R., & Vermeulen, W. J. V. (2020). The assessment of positive impacts in LCA of products. *The International Journal of Life Cycle Assessment*, *26*, 143–156. https://doi.org/10.1007/s11367-020-01820-x

Croes, P. R., & Vermeulen, W. J. V. (2021). The assessment of positive impacts in LCA of products. *International Journal of Life Cycle Assessment*, *26*, 143–156. https://doi.org/10.1007/s11367-020-01820-x

de Adelhart Toorop, R., Yates, J., Watkins, M., Bernard, J., & de Groot Ruiz, A. (2021). Methodologies for true cost accounting in the food sector. *Nature Food*, *2*(9), 655–663. https://doi.org/10.1038/s43016-021-00364-z

Enneking, L. F. H., & Veldman, J. (2021). Towards responsible business conduct in global value chains. Relevant legal developments in the Netherlands. *Erasmus Law Review*, *4*, 1–5. https://doi.org/10.5553/ELR.000178

Goodstein, E. (2014). *Economics and the environment*. Wiley.

Gruber, J. (2018). *Public finance & public policy* (3rd ed.). Worth Publishers.

Heijungs, R., Huppes, G., & Guinée, J. B. (2010). Life cycle assessment and sustainability analysis of products, materials and technologies. Toward a scientific framework for sustainability life cycle analysis. *Polymer Degradation and Stability*, *95*(3), 422–428. https://doi.org/10.1016/j.polymdegradstab.2009.11.010

Huysveld, S., Taelman, S. E., Hackenhaar, I. C., Zanchi, L., Kujanpää, L., Harmens, R., Zamagni, A., Bianchi, M., van der Kamp, J., Bachmann, T. M., & Alvarenga, R. (2021). *Critical evaluation of sustainability integration approaches*. Ghent University. https://www.orienting.eu

International Organization for Standardization (ISO). (2019). *ISO 14008—Monetary valuation of environmental impacts and related environmental aspects (ISO 14008:2019)*.

Laufer, W. S. (2003). Social accountability and corporate greenwashing. In. *Journal of Business Ethics*, *43*(3), 253–261. https://doi.org/10.1023/A:1022962719299

Morioka, S. N., & de Carvalho, M. M. (2016). A systematic literature review towards a conceptual framework for integrating sustainability performance into business. *Journal of Cleaner Production*, *136*, 134–146. https://doi.org/10.1016/j.jclepro.2016.01.104

Parguel, B., Benoît-Moreau, F., & Larceneux, F. (2011). How sustainability ratings might deter "greenwashing": A closer look at ethical corporate communication. *Journal of Business Ethics*, *102*, 15–28. https://doi.org/10.1007/s10551-011-0901-2

Pizzol, M., Weidema, B., Brandão, M., & Osset, P. (2015). Monetary valuation in life cycle assessment: A review. *Journal of Cleaner Production*, *86*, 170–179. https://doi.org/10.1016/j.jclepro.2014.08.007

Ramus, C. A., & Montiel, I. (2005). When are corporate environmental policies a form of greenwashing? *Business & Society*, *44*(4), 377–414. https://doi.org/10.1177/0007650305278120

Seele, P., & Gatti, L. (2017). Greenwashing revisited: In search of a typology and accusation-based definition incorporating legitimacy strategies. *Business Strategy and the Environment*, *26*(2), 239–252. https://doi.org/10.1002/bse.1912

Thies, C., Kieckhäfer, K., Spengler, T. S., & Sodhi, M. S. (2019). Operations research for sustainability assessment of products: A review. In *European Journal of Operational Research* (Vol. *274*, Issue 1, pp. 1–21). Elsevier B.V. https://doi.org/10.1016/j.ejor.2018.04.039

van den Beucken, N., Daim, B. H., Croes, P. R., Vermeulen, W. J. V., & van der Feen, L. (2022). *Oiconomy Pricing—Real price of a stone kitchen countertop*. Utrecht University. https://doi.org/10.5281/zenodo.6535581

Vermeulen, W. J. V. (2015). Self-governance for sustainable global supply chains: Can it deliver the impacts needed? *Business Strategy and the Environment*, *24*(2), 73–85. https://doi.org/10.1002/bse.1804

Vermeulen, W. J. V. (2018). Substantiating the rough consensus on concept of sustainable development as point of departure for indicator development (accepted manuscript version). In S. Bell & S. Morse (Eds.), *Routledge handbook of sustainability indicators* (pp. 59–90). Routledge. https://www.routledge.com/Routledge-Handbook-of-Sustainability-Indicators/Bell-Morse/p/book/9781138674769. https://doi.org/10.4324/9781315561103-4

Vermeulen, W. J. V., Croes, P. R., & van der Feen, L. (2022). Oiconomy/RVO pilot project—Report. https://doi.org/10.5281/zenodo.6480958

Vermeulen, W. J. V., & Witjes, S. (2016). On addressing the dual and embedded nature of business and the route towards corporate sustainability. *Journal of Cleaner Production*, *112*(12), 1–15. https://doi.org/10.1016/j.jclepro.2015.09.132

Verschuren, E.-J., Croes, P. R., Vermeulen, W. J. V., & van der Feen, L. (2022). *Oiconomy Pricing—Real price of pepper from Indonesia*. Utrecht University. https://doi.org/10.5281/zenodo.6521996

Visentin, C., Trentin, A. W. d. S., Braun, A. B., & Thomé, A. (2020). Life cycle sustainability assessment: A systematic literature review through the application perspective, indicators, and methodologies. *Journal of Cleaner Production*, *270*, 122509. https://doi.org/10.1016/j.jclepro.2020.122509

Vogtländer, J. G., & Bijma, A. (2000). The 'virtual pollution prevention costs '99'. *The International Journal of Life Cycle Assessment*, *5*(2), 113–120. https://doi.org/10.1007/BF02979733

Vogtländer, J. G., Brezet, H. C., & Hendriks, C. F. (2001). The virtual eco-costs '99 A single LCA-based indicator for sustainability and the eco-costs-value ratio (EVR) model for economic allocation. *The International Journal of Life Cycle Assessment*, *6*(3), 157–166. https://doi.org/10.1007/BF02978734

Weidema, B., Brandão, M., & Pizzol, M. (2013). The use of monetary valuation of environmental impacts in life cycle assessment: State of the art, strengths and weaknesses.

Wever, R., & Vogtländer, J. (2013). Eco-efficient value creation: An alternative perspective on packaging and sustainability. *Packaging Technology and Science*, *26*(June), 229–248. https://doi.org/10.1002/pts.1978

Witjes, S., Cramer, J. M., & Vermeulen, W. J. V. (2018). On corporate sustainability integration and the support of tools. *World Review of Entrepreneurship, Management and Sustainable Development*, *14*(5), 581–607. https://doi.org/10.1504/WREMSD.2018.094332

World Business Council for Sustaibale Development (WBCSD). (2022). *CEO guide to the sustainable development goals*.

How to cite this article: Vermeulen, W. J. V., Croes, P. R., & van der Feen, L. (2023). Piloting Oiconomy Pricing: First experiences of producers applying full cost sustainability assessment of products. *Business Strategy and the Environment*, *32*(7), 4924–4937. https://doi.org/10.1002/bse.3400