

SMART DELIVERABLE D5.6

Testing Sustainability Assessment Tool in the selected case studies from Textile and Mobile Phone Sectors



We study the barriers and drivers for market actors' contribution to the UN Sustainable Development Goals within planetary boundaries, with the aim of achieving Policy Coherence for Sustainable Development.

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Executive summary

Since the Paris Agreement on Climate Change in 2015 and the adoption of the UN Sustainable Development Goals (SDGs) in 2015, the EU Action Plan for financing Sustainable Growth in 2018 and the EU Directive on Non-Financial Information in 2014, among other initiatives around the world to promote sustainability, the EU and the global community has been developing a new agenda on how to face the most urgent global problems challenging today's world.

This report allows showing, through the testing of the Sustainability Assessment Framework, the suitability of the Sustainability Assessment Framework designed in the SMART project to assess the corporate sustainability of companies, including the supply chain management at a global level.

Despite the many efforts for turning sustainability assessment into accurate and universal tools, there is today no internationally accepted framework that integrates the whole sustainability principles defined in the deliverable D5.1 "Lifecycle thinking: issues to be considered" (Three dimensions of sustainability, Inter-generational perspective, Stakeholder approach and Lifecycle thinking) into the corporate sustainability assessment process.

In this context, the SMART project Sustainability Assessment Framework provides an integral solution to these problems and provides a science-based framework for analyzing the extent to which companies are operating sustainably. The Framework is applicable to any kind of organization, regardless of its size, structure, business area and location, and it is intended to be used to analyze the sustainable management of an organization within its supply chain using a lifecycle perspective.

The Sustainability Assessment Framework presents three processes -Traceability in the product's sustainable management, Assurance, and Continuous improvement- and three steps -Organization sustainability framework analysis, Sustainability assessment tool, and Reporting Tool.

From a theoretical perspective, the suitability of the Sustainability Assessment Framework is based on two core issues: i) it performs according to the above mentioned basic sustainability principles; and ii) it integrates corporate sustainability assessment, management accounting, management control and reporting tools in a consistent way according to these principles.

To that end, the main strengths and weaknesses regarding the implementation of the Sustainability Assessment Framework have been analyzed, through a testing process based on two case studies, with three different scenarios each one, belonging to two sectors, the textile and mobile phone producer.

In each of the two sectors, three different scenarios have been considered. Even though the use of scenarios is a simplification of reality, it increases the soundness of the study and enriches the conclusions, allowing to detect potential differences depending on the lifecycle features defined in each scenario.

Regarding the textile company, the case study focuses on a company which produces only one product, cotton-made t-shirts. With respect to the mobile phone company, the case study is based on a company that produces also only one product, a smart mobile phone.

The results obtained during the testing process reinforce the theoretical arguments that support the Sustainability Assessment Framework proposed by WP5:

(i) The Sustainability Assessment Framework should integrate the sustainability principle of 'Balance between the economic, social and environmental dimensions of sustainability'. In the context of the testing process carried out, the relevance of this principle becomes especially evident in the study of the different simulated scenarios. In the case of the textile sector, if we analyze the variability showed by environmental impacts depending on the defined scenario, the decision to operate in developed countries has little negative environmental impacts except in the case of 'Water resource' (in this case it is significantly reduced), and in some cases impacts are worse (i.e. 'Ionizing radiation'); however, all the social impact categories improve without exception. Consequently, in a holistic analysis, and according to the technical analysis carried out,

reuse decisions in low-income countries (scenario 2) hardly reduce environmental and social impacts when comparing to the improvement of the business' socio-political environment scenario (scenario 3, with all the lifecycle phases in the USA) being the most relevant strategy to improve the social and environmental performance.

Considering the mobile phone analysis, the results presented in the three scenarios show little impact of recycling strategies (highlighted in scenario 2): they are very discrete in environmental terms, but especially irrelevant in social terms. However, the promotion of reuse strategies by companies (scenario 3) will improve substantially, not only their environmental impact, but also their social impact. This fact could have implications in terms of new, more circular, business models, where reusing is the main reference for reducing social and environmental footprints. Whilst this seems clear for improving the social and environmental impacts, the strategy deserves an in-depth analysis regarding its economic performance. Research should advance in addressing the extension of lifecycle strategies to also achieve economic sustainability, both for the company and for society.

(ii) The Sustainability Assessment Framework should integrate the sustainability principle of 'Stakeholder approach'. This is addressed along the whole framework, but especially during the hotspots analysis phase. The results of WP3 and WP4 stakeholder-based hotspots analyses are perfectly integrable with the outputs from the footprints.

(iii) The Sustainability Assessment Framework should include the sustainability principle called 'Intergenerational perspective'. The above-mentioned hotspots analysis together with the continuous improvement process allow framework users to consider risks beyond the short term, thus incorporating in future revisions of the framework solutions to the shortcomings detected by the company during the use of the framework.

(iv) Sustainability Assessment Frameworks should integrate the sustainability principle of 'Lifecycle thinking'. Sustainability assessment processes that do not consider the impacts along the product lifecycle might present distorted results. For instance, in the textile sector, companies belonging to the 'Garment manufacturing' lifecycle phase (with low environmental impact) may present very good environmental performance indicators

even for high pollutant products, because the main environmental impacts take place in previous lifecycle phases, such as 'Raw material acquisition' (especially in terms of 'Water resource depletion' impact category), or 'Fabric production' (regarding 'Human toxicity - cancer effects' impact category). Similar conclusions are obtained from the testing process in the mobile phone sector, where the main environmental impact category is 'Mineral fossil and resource depletion', which occurs during the first lifecycle phase.

Finally, to highlight the importance of the use of the framework, the measurement of social, economic and environmental impacts of a company is not treated as isolated actions. They reflect the sustainability performance of a company in terms of management, control and reporting structures. The analysis developed regarding the implications in each of the phases and processes of the Sustainability Assessment Framework proposed by WP5 for each of the case studies, denotes the relevance of maintaining this consistency along the whole assessment and the guarantees defined for that purpose, combining science-based techniques with expert knowledge and political interests (stakeholders' expectations and needs).

Glossary

Corporate Governance Management for Sustainability: is the application of managerial tools and mechanisms to the full range of governance needs, to govern at the highest level with the objective to achieve a more sustainable development.

Data: In terms of communication, data only describe a part of what happened, and do not include opinions or interpretations. Therefore, only data does not represent a solid base for the continuous improvement of measures and their implementation.

Footprint: A tool, which integrates a lifecycle approach and defines a comprehensive range of environmental, social or economic impact categories that could be directly related, not only to the most significant global challenges, but also to every potential hotspot that a company could manifest.

Framework: A basic structure underlying a system, concept, or text.

Guide: A document providing information on a subject.

Information: It has a meaning and shows significance, a purpose, and a form or style to connect with the public.

Organization Environmental Footprint - Organizational Boundaries: All facilities and associated processes that are fully or partially owned and/or operated by the organization and that directly contribute to the provision of the Product Portfolio.

Organization Environmental Footprint (OEF): European initiative to measure the environmental performance of an organization from a lifecycle perspective based on fourteen impact categories: Climate change; ozone depletion; ecotoxicity - fresh water; human toxicity - cancer effects; human toxicity - non-cancer effects; particulate matter/respiratory inorganics; ionizing radiation - human health effects; photochemical ozone formation; acidification; eutrophication - terrestrial; eutrophication - aquatic; resource depletion - water; resource depletion - mineral and fossil and land use.

Organization Environmental Footprint Boundaries: Boundaries that shall be defined following a general supply-chain logic and which include site-level (direct) activities, upstream (indirect) activities and downstream (indirect) activities associated with the Organization's Product Portfolio. The OEF boundaries allow for the exclusion of downstream (indirect) activities as long as an explicit justification is provided.

Planetary boundaries: Environmental framework based on a set of nine planetary boundaries within which humanity can continue to develop and thrive for generations to come.

Social Foundation: Social framework that presents the minimum social standards, which define the socially just space in which humanity can thrive.

SOGRES-MF Economic Footprint: SOGRES-MF is an initiative to measure the economic performance of an organization from a lifecycle perspective that is based on six impact categories: business survivorship, taxes, efficiency, compliance, employment and inequality.

Sustainability Assessment Framework: A structure underlying the sustainability assessment system proposed by the H2020 SMART project. In specific cases, it is used acronym SAF.

Sustainability Assessment Tool: A step in the Sustainability Assessment Framework that integrates tools that measure the sustainability performance of an organization in terms of its environmental, social and economic impact, and the adequacy of its hotspot management. In specific cases, it is used acronym SAT.

Sustainability Principles: The principles form the basis to operationalize sustainability, which comprises a multidimensional perspective (environmental, social, governance and economic dimensions) with a balance between the different dimensions, an intergenerational perspective, the introduction of lifecycle thinking and a process of dialogue and negotiation among different actors.

Sustainable Development Goals: The Sustainable Development Goals (SDGs) are an intergovernmental set of development goals that were adopted by all United Nations Member States in 2015. They have replaced the Millennium Development Goals. The SDGs are made up of 17 goals and 169 indicators.

System: A set of principles or procedures according to which something is done; an organized scheme or method.

Traceability: It is the process of identifying and tracking a product's or component's path from raw material to finished good. It is a practical approach for organizations to advance sustainability in global supply chains and prove claims and attributes of sustainable products or services.

UNEP-SETAC Social Footprint: UNEP-SETAC is an initiative that measures the social performance of an organization from a lifecycle perspective based on five stakeholder categories: workers/employees, consumers, local community, society and value chain actors (not including consumers).

Presentation of Deliverable

Purpose and scope

This deliverable presents the results of the testing process of the logical framework to assess sustainability, presented in SMART project Deliverables 5.4 and 5.5. This testing process has been carried out in two different case studies belonging to two sectors, textiles and mobile phones. This work is also connected to SMART project Deliverable D5.2 'List of Best Practices and KPIs of the Textile Products Lifecycle' and D5.3 'List of Best Practices and KPIs of the Mobile Phone Lifecycle', which are complementary documents that support the sectoral analysis of this testing process.

This deliverable will test the suitability of the Sustainability Assessment Framework designed in the SMART project to assess the corporate sustainability of companies, including the supply chain management at a global level.

Relationship to other deliverables

This SMART deliverable D5.6, 'Public Report: Results of the testing process in the selected case studies', attempts to apply the Sustainability Assessment Guide provided under deliverable D5.4 'Report with the Sustainability Assessment Guide', and the deliverable D5.5 'Proposal of Multi-Criteria Decision-Making Methodology to Assess the Supply Chain Management'. It is based on the work developed by WP5 and the results obtained by the WP3 and WP4 regarding the social and environmental hotspots analysis of the Textile Products Lifecycle and the Mobile Phone Lifecycle, respectively.

This is the last deliverable of the WP5, and it will contribute to the identification of strengths and weaknesses regarding the implementation of the Sustainability Assessment Framework, as well as allowing to illustrate an assessment of the corporate sustainability beyond organizational boundaries and under the sustainability principles.

The results of this deliverable will feed into the WP2 reform proposals to encourage a more responsible trade, since the application of the Sustainability Assessment Framework will provide useful information for decision-making processes to be taken by different market actors in terms of sustainability.

Structure of the document

The objective of this deliverable is to test the Sustainability Assessment Framework for organizations in two simulated companies. To that end, this document is divided into three sections. The first section presents the Sustainability Assessment Framework outline, including a brief summary of the three processes and the three steps included in the framework. The second section describes the case studies and scenarios used to test the Sustainability Assessment Framework. Finally, the third section addresses the results of the application of the Sustainability Assessment Framework in the two fictitious companies divided by the three processes (traceability, assurance and continuous improvement) and the three steps (organization sustainability framework analysis; sustainability assessment tool and reporting tool) that comprise the Sustainability Assessment Framework.

1. Sustainability Assessment Framework Outline

The Sustainability Assessment Framework (SAF) presented in D5.4 has been designed to cover the assessment complexity of organizations along the whole supply chain and with a clear focus on connecting organizations' sustainability with the sustainability of their supply chains, taking into account not only direct impacts, but also upstream and downstream ones.

This Sustainability Assessment Framework (Figure 1) presents three processes and three steps that offer a holistic system to ensure the success of the appraisal. The main characteristics of each of the processes and steps are summarized below:

Process 1: Traceability in the product's sustainable management: Interoperability mechanisms must be defined to ensure traceability. The framework should consider the traceability of the sustainable management of products, which allows for the analysis of direct and indirect impacts of the organization.

Process 2: Assurance: The whole sustainability assessment process should contain enough guarantees to ensure that the information that comes out of the process is relevant, reliable and provides confidence to the different stakeholders.

Process 3: Continuous improvement: The organization must work towards improving its sustainability practices, processes and performance, leading to the gradual extension of the scope of the Sustainability Assessment Framework implementation over time.

Step 1: Organization sustainability framework analysis: In this phase, the organization should define the following aspects: 1) board commitment, 2) corporate governance connection to sustainability, 3) objectives and scope, 4) the organization position within the supply chain, 5) its main impacts throughout the lifecycle, 6) its supply chain map, 7) its stakeholders, 8) the evaluation process future improvements and, 9) the sustainability strategy.

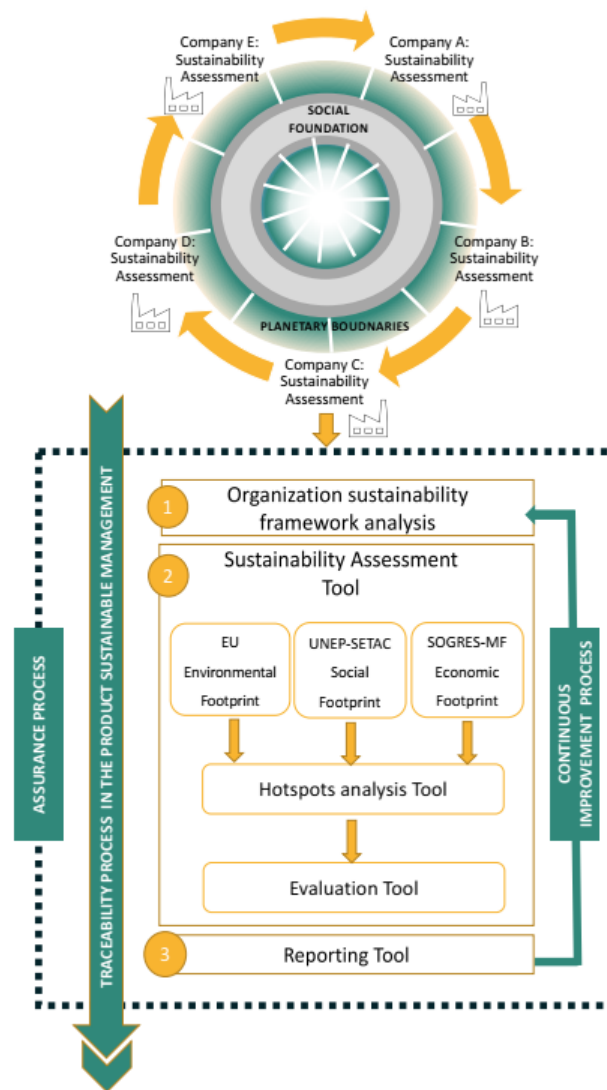
Step 2: Sustainability assessment tool: This step comprises three phases:

Phase 1: Footprints tools: The framework offers footprint methodologies to identify and measure environmental, social and economic impacts (see SMART Deliverable 5.5).

Phase 2: Hotspots analysis tool: In this phase, the critical points of the organization under evaluation are determined.

Phase 3: Evaluation tool: In the third phase, the results obtained in phases 1 and 2 are considered to evaluate sustainability performance, based on multi-criteria decision-making methodologies. This phase provides organizations with the so-called sustainability footprint.

Figure 1. General outline of the sustainability assessment framework



Source: Deliverable D5.4¹

¹ Muñoz-Torres, M.J., Fernandez-Izquierdo, M.A., Rivera-Lirio, J.M., Ferrero-Ferrero, I., Escrig-Olmedo, E., Gisbert-Navarro, J.V. (2019) "D5.4 Sustainability assessment guide" Public Report, SMART H2020 Project, Available online: https://www.smart.uio.no/publications/reports/d.5.4-v0.2_wp5.pdf

Step 3: Reporting Tool: In this step, organizations measure and communicate to internal and external stakeholders their environmental, social and management performance, and then set goals to manage change more effectively.

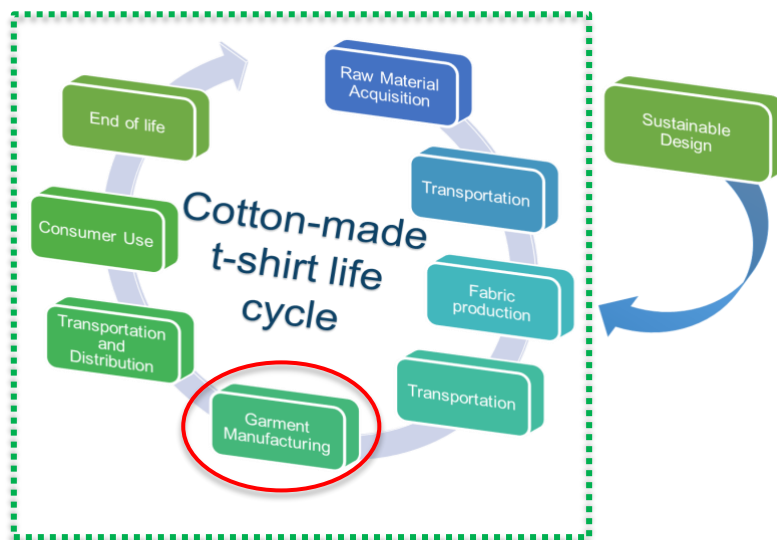
2. Case studies definition

The testing process of the Sustainability Assessment Framework has been carried out in two fictitious companies, one that operates in the textile sector and one from the mobile phone production sector. For each case study, three different scenarios have been considered in order to enrich the analysis.

2.1. Textile sector case study definition

Regarding the textile company, the case study focuses on a company which produces only one product, cotton-made t-shirts. This is one of the best-selling items of clothing in Europe². Figure 2 shows the main phases of cotton-made t-shirt lifecycle and highlights the garment manufacturing phase as the phase associated with the case analyzed.

Figure 2. Cotton-made t-shirt lifecycle



Source: Deliverable D5.2³







² Beton, A., Dias, D., Farrant, L., Gibon, T., Le Guern, Y., Desaxce, M., Perwuelz, A., Boufete, I., Woldf O., Kougoulis M.C, Cordella, M., and Dodd N. (2014). "Environmental improvement potential of textiles (IMPRO-Textiles)". European Commission. Available online: http://publications.jrc.ec.europa.eu/repository/bitstream/JRC85895/impro%20textiles_final%20report%20edited_pubsy%20web.pdf (accessed on 25 February 2019).

³ Muñoz-Torres, M.J., Fernandez-Izquierdo, M.A., Rivera-Lirio, J.M., Ferrero-Ferrero, I., Escrig-Olmedo, E., Gisbert-Navarro, J.V. (2018) "D5.2 List of best practices and KPIs of the textile products lifecycle" Public Report, SMART H2020 Project, Available online:

Considering the cotton-made t-shirt lifecycle and the companies integrated in this lifecycle, three scenarios have been defined to analyze the main cotton-made textile industry hotspots in terms of sustainability (For more details see Muñoz-Torres et al, 2020)⁴.

Scenario 1 (Table 1): The cotton for the t-shirt stems from the USA (15.6%), China (29.8%) and the rest of the world, mainly India and Pakistan, (54.6%). During the period of its use, it is estimated that on average, a t-shirt is washed and dried for 50 cycles. At the end-of-life phase, t-shirts are thrown away to a landfill in Germany (treatment of municipal solid waste) and no recycling is considered.

Table 1. Lifecycle stages of the cotton t-shirts without reuse

Raw material acquisition	Transport	Fabric production	Transport	Garment manufacturing	Transport	Use	End of life
USA: 15.6%	 Sea transportation (10405 Km)	China (Luannan)	 Sea transportation (15552 Km)	 Turkey (Izmir)	 Ground transportation (27772 Km)	Germany (Hamburg) - 50 washings & dryings - Cardboard box & Plastic container	Germany (Hamburg)
China: 29.8%	 Railway transportation (334 Km)						
Rest of the World: 54.6%	 Sea transportation (10317 Km)						

Source: Muñoz-Torres et al. (2020)⁵

Scenario 2 (Table 2): This scenario is based on scenario 1, but additionally, the cotton-made t-shirts are reused as second-hand items of clothing. In a phase of use, in Germany, t-shirts are washed and dried for 40 cycles during the period of use. After that, there is a reuse phase in a low-income country








<https://ec.europa.eu/research/participants/documents/downloadPublic?documentIds=080166e5bd4e507d&appId=PPGMS> (accessed on 13 November 2019)

⁴ Muñoz-Torres, M.J., Fernandez-Izquierdo, M.A., Rivera-Lirio, J.M., Ferrero-Ferrero, I., Escrig-Olmedo, E., (2020), "Sustainable supply chain management in a global context: A consistency analysis in the textile industry between environmental management practices at company level and sectoral and global environmental challenges", Journal of Environment, Development and Sustainability, forthcoming

⁵ Muñoz-Torres et al. (2020) (as n.4 above)

(in this case, Ivory Coast) where a t-shirt is hand-washed for 25 cycles. At the end-of-life stage, the t-shirt is treated as municipal solid waste in Ivory Coast (incinerated).





Table 2. Lifecycle stages of the cotton t-shirt with reuse

Raw material acquisition	Transport	Fabric production	Transport	Garment manufacturing	Transport	Use	Transport	Reuse	End of life
USA:15.6%	 Sea transportation (10405Km)		 Sea transportation (15552Km)	 Turkey(Izmir)	 Ground transportation (27772Km)	Germany (Hamburg) 40 washings& dryings Cardboard box&Plastic container	 Sea transportation (7357Km)	Ivory Coast (Abidjan) 25 hand-washings	Ivory Coast (Abidjan)
China:29.8%	 Railway transportation (334Km)	China (Luannan)							
Rest of the World:54.6%	 Sea transportation (10317Km)								

Source: Muñoz-Torres et al. (2020)⁶

Scenario 3 (Table 3): In this scenario, a fully local life cycle has been defined. All companies and users from different the lifecycle stages, from cotton productions to end of life management of cotton-made t-shirts occur inside the USA.

Table 3. Lifecycle stages of the cotton t-shirt in the USA

Raw material acquisition	Transport	Fabric production	Transport	Garment manufacturing	Transport	Use	End of life
USA (Lubbock, Texas)	 Ground transportation (2171 Km)	USA (Gastonia, North Carolina)	 Ground transportation (60 Km)	 USA (Gaffney, South carolina sur)	 Railway transportation (1108 Km)	USA (New York) 50 washings & dryings -Cardboard box & Plastic container	USA (New York)

Source: Muñoz-Torres et al. (2020)⁷

⁶ Muñoz-Torres et al. (2020) (as n.4 above)

⁷ Muñoz-Torres et al. (2020) (as n.4 above)

2.2. Mobile phone sector case study definition

With respect to the mobile phone company, the case study is based on a company that produces only one product, mobile phones, which is composed of the following components that are included in Figure 3:

- Electronics: electronic components and board
- Screen: LCD type
- Housing: polycarbonate
- Battery: lithium
- Charger: low voltage transformer, incl. cable and connectors
- Package (carton)
- Packaging (plastic)

In the mobile phone company, which belongs to the ‘final assembling’ lifecycle phase, the scenarios considered only affect the ‘End-of-Life’ phase, changing the percentages of the mobile phone’s residue allocated to landfill, disassembly and reuse detailed below:

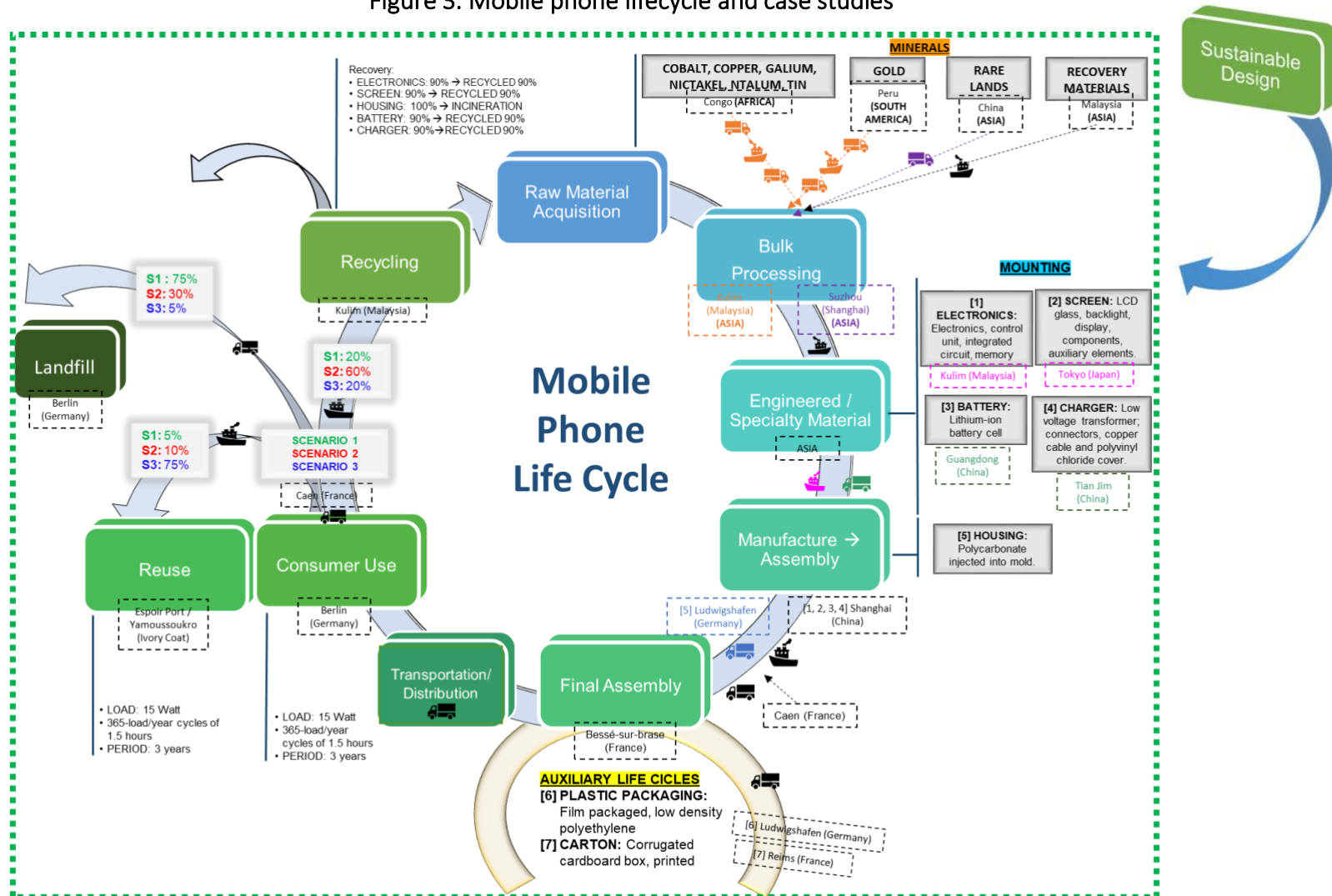
Scenario 1: Sent to Landfill: 75%; sent to Disassembly: 20%; Reuse: 5%

Scenario 2: Sent to Landfill: 30%; sent to Disassembly: 60%; Reuse: 10%

Scenario 3: Sent to Landfill: 5%; sent to Disassembly: 20%; Reuse: 75%

Figure 3 shows the main phases of a mobile phone lifecycle and defines the three scenarios that have been considered to apply the SAF.

Figure 3. Mobile phone lifecycle and case studies



Source: Own creation based on the Mobile phone lifecycle from Deliverable D5.3⁸

⁸ Muñoz-Torres, M.J., Fernandez-Izquierdo, M.A., Rivera-Lirio, J.M., Ferrero-Ferrero, I., Escrig-Olmedo, E., Gisbert-Navarro, J.V. (2018) "D5.3 List of best practices and KPIs of the mobile phone lifecycle" Public Report, SMART H2020 Project, Available online: <https://ec.europa.eu/research/participants/documents/downloadPublic?documentIds=080166e5bd4e507f&appId=PPGMS> (accessed on 13 November 2019)

3. Sustainability Assessment Framework: testing process

During the next sections, the Sustainability Assessment Framework (SAF) will be applied to the two case studies previously defined.

As these are simulations, it is noted that the technical information regarding social and environmental impacts has been obtained from specialized databases (Step 2, phase 1) and expert knowledge (Step 2, phase 2). To the best of our knowledge, there is no database that addresses the economic impacts defined in the economic footprint. Therefore, it has not been possible to estimate the economic impacts of both cases.

Information related to corporate management structures and processes has been defined in general terms considering the most favorable position towards sustainability, without developing in detail the specificities that the hypothetical company should have inside its sustainability management and information systems. In particular, this affects the processes of traceability, assurance and continuous improvement, the Step 1 Organization sustainability framework analysis and the Step 3 Reporting Tool.

The Step 2, phase 3 of the Sustainability Assessment Framework has not been implemented given that the normalization, weighting and aggregation of impact categories of the science-based methodologies that integrate this step (environmental and social footprint) are still under development. Nonetheless, this deliverable has included the related section in order to explain how the simulated companies should theoretically implement the Step2, phase 3 of the SAF.

3.1. Process 1: Traceability in the sustainable management

Sustainability Assessment Framework shall improve the traceability of the sustainable management of organizations, which allows for the analysis of direct and indirect impacts of the organization, not only in environmental terms, but also in social and economic terms along their value chain.

In both cases, it is assumed that the companies have defined a process that allows to identify and track the products and components' path from raw material to product end of life by means of interoperability mechanisms. These mechanisms will connect different organizations through the flow of products knowing their origins, processing, distribution and location, thus relating their sustainability loads (Table 4). In addition, both companies use sustainability clauses in supply chain contracts and their communication through the entire production process.

Table 4. Case studied: traceability mechanisms considered

Dimension	Check list Simulation
Chain traceability	The organizations define mechanisms to track the movement of products in multiple processes, and between organizations.
Internal traceability	The organizations define mechanisms to track the movement of products within a single process or organization.

3.2. Process 2: Assurance

The whole sustainability assessment process should contain enough guarantees to provide confidence and reliable information to the different stakeholders. To this end and in this phase, internal and external auditing processes should be defined and established.

The objective of the Sustainability Assessment Framework assurance process is to draw an accurate conclusion concerning the reliability of the Framework, in order to provide confidence and ensure reliable information to the different stakeholders regarding the sustainability assessment process performed.

This implies the development of a consistent assurance process, which analyzes, phase by phase, the fulfilment of the Sustainability Assessment Framework principles related to content and related to confidence in data quality and results (Figure 4).

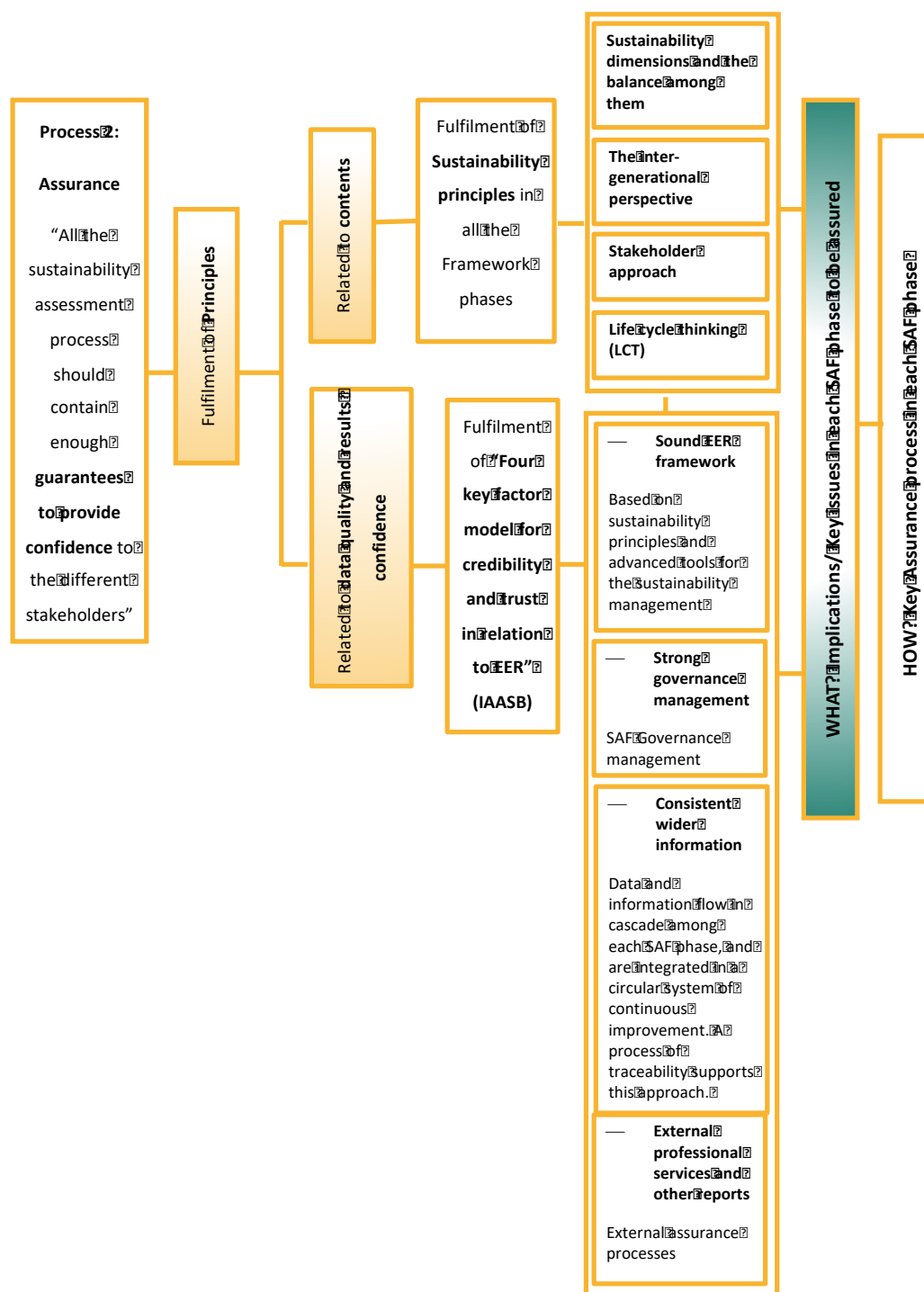
Considering this framework, the Sustainability Assessment Framework assurance process requires a deep analysis of key issues in each Sustainability Assessment Framework phase (*'What is to be assured?'*), in order to guarantee consistency between the Sustainability Assessment Framework phases performed and the Sustainability Assessment Framework general framework.

In addition, the Sustainability Assessment Framework assurance process includes an assurance methodology based on the most suitable available tool for each Sustainability Assessment Framework phase (*'How? Assurance tool in each Sustainability Assessment Framework phase'*).

To implement this assurance process, the intervention of qualified and independent external assurance providers is required, who need to be accredited experts in the respective fields. The heterogeneity of issues to be assured could require the participation of different professionals. In this case, the assurance shall be performed by an external assurance providers' team, coordinated by a senior member.

In this deliverable, it is not possible to test the assurance process, as for this it is necessary to apply it to a real organization that has previously implemented the Sustainability Assessment Framework. However, the assurance process has been defined based on the integration of current standards on non-financial information verification.

Figure 4. Sustainability Assessment Framework Assurance Process Framework



Source: Deliverable D5.4⁹

⁹ Muñoz-Torres et al. (2019) (as n.1 above)

3.3. Process 3: Continuous improvement

The Sustainability Assessment Framework adopts a 'continuous improvement approach', which implies that the organization must work towards improving its sustainability practices, processes and performance, leading to the gradual extension of the scope of the Sustainability Assessment Framework implementation; the gradual mitigation of negative impacts and the establishment of a more demanding sustainability objectives over time.

The Sustainability Assessment Framework structure has been designed in a way that data and information flow in cascade along each Sustainability Assessment Framework step. These flows are integrated in a circular system of continuous improvement, supported by Process 2, Traceability. Consequently, the Sustainability Assessment Framework processes and tools are performed under a dynamic sustainability management thinking, whereby the sustainability assessment contributes to positioning the organization in a global sustainable development strategy according to its sustainability impacts, but also reinforces the consistency and reliability of the organization's sustainability management across time.

The integration of a continuous improvement management system in the Sustainability Assessment Framework implies that outputs in each of the Sustainability Assessment Framework steps have a twofold objective: i) to allow the organization to perform sustainability assessment under Sustainability Assessment Framework definitions, and ii) to provide consistent and reliable information for a better sustainability assessment in the next period.

Table 5 reflects the hypothetical integration of the continuous improvement approach in the assessment framework considered for the two cases analyzed, using the established management process "Plan-Do-Check-Act" (PDCA) cycle as reference.

Table 5. Cases studied: Continuous improvement approach considered

Dimension	Check list Simulation
<u>Plan:</u> Step 1- Organization sustainability framework analysis.	The organization integrates the results and improvement proposals of previous assessments, especially in its definition of objectives, scope, impacts throughout the lifecycle, methodology for identifying stakeholders, and sustainability strategy.
<u>Do:</u> Step 2- Sustainability Assessment Tool	It is considered a recursive technical review of footprint calculus of the Sustainability Assessment Framework, and a recursive review of hotspots analysis and management.
<u>Check:</u> Assurance Process and Step 3- Reporting Tool	In both parts of the system, it is possible to identify weaknesses and future preventive and/or corrective actions to be considered. In addition, they can help open up dialogue with stakeholders and, as result, obtain issues to be considered in future Sustainability Assessment Framework processes.
<u>Act:</u> Step 1- Organization sustainability framework analysis in the future.	Results derived from the application of Sustainability Assessment Framework are considered by the organization in order to improve the application of the Framework in the next periods.

3.4. Step 1: Organization Sustainability Framework Analysis

In this phase, the organization should: 1) determine board commitment; 2) connect corporate governance to sustainability; 3) know its objectives and scope; 4) position the organization within the supply chain; 5) be aware of its impacts throughout the lifecycle; 6) define its supply chain map; 7) identify its stakeholders; 8) move forward in the evaluation process, and; 9) plan for the sustainability strategy.

With respect to the **determination of the board commitment**, it is assumed that the companies have developed a statement, which evidences the company formal commitment to sustainability.

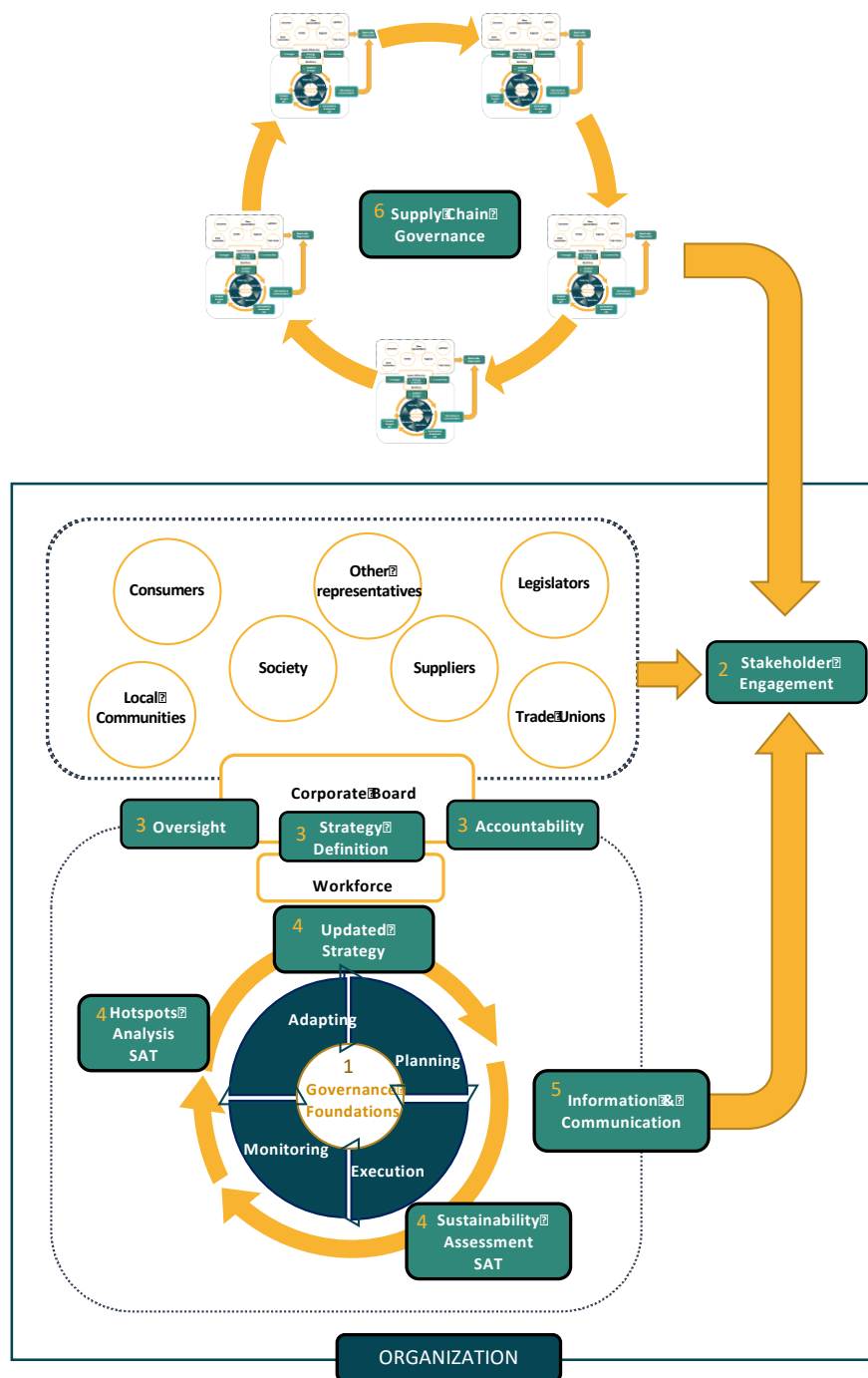
As far as the **connection of corporate governance with sustainability** is concerned, the Sustainability Assessment Framework defines the corporate governance bases divided into six action areas, which address critical issues in corporate governance and sustainability (Figure 5): governance foundations, stakeholder engagement, internal governance structures, tools for board's due diligence, sustainability information and communication and governance mechanisms for the supply chain.

The Sustainability Assessment Framework proposes the use of the following five types of governance mechanisms: (i) a common inter-organizational sustainability framework agreement; (ii) sustainability criteria in purchasing/selling activities; (iii) contractual clauses on sustainability issues; (iv) problem-solving collaborations, and; (v) information sharing among the different actors of the supply chain.

The third key question regards the **knowledge and scope of the sustainability assessment** and its contribution to the global corporate strategy. The company should clearly establish the scope of the sustainability assessment, including, where possible, the environmental, social and economic impacts along the supply chain, i.e. direct and indirect impacts, considering upstream and downstream processes.

It is also necessary for **the company to position itself within the supply chain**. The sustainability assessment could be affected by context-dependent factors. For this reason, it is important that the company specifies its activities' sector/s and location as well as the generic supply chain with locations and the stages of the supply chain, which the company belongs to.

Figure 5. Corporate Governance Management bases to run businesses in a sustainable way



Source: Deliverable D5.4¹⁰

¹⁰ Muñoz-Torres et al. (2019) (as n.1 above)

For the assessment of sustainability beyond organizational boundaries, improving corporate sustainability, keeping risks at a minimum level and ensuring traceability, companies should **define its supply chain map**, which is a list of direct (tier 1) and indirect suppliers (beyond immediate tier 1 suppliers), their location and the connection with the organizational activity. This supplier registration can be a complex process and it is recommended to use data management software as support.

Another relevant question for the Organization Sustainability Framework Analysis is the **identification of the company's stakeholders**, that is those individuals or groups that affect or/and can be affected by the company's activities. In a sustainability context, the company should move beyond engaging only with traditional stakeholders (e.g. shareholders or owners) and engage with other key groups (e.g. consumers, suppliers, communities or innovators).

The Sustainability Assessment Framework is based on the continuous improvement approach, meaning that the company should institutionalize a culture of continuous improvement that entails **moving forward on achieving sustainability**, by setting increasingly more demanding environmental, social and economic targets, expanding the scope of the assessment and getting better and better at mitigating negative impacts.

Finally, in a Sustainability Assessment Framework, it is key that the **integration of sustainability into the organization's strategy** be considered, including a map of short, medium and long-term plans, the definition of goals in terms of sustainability considering also stakeholders' needs and expert knowledge, the development of a system of indicators for measuring and controlling it, and the inclusion of sustainability concerns in training schemes and staff incentives.

Table 6 presents the main features defined for the Organizational Sustainability Framework Analysis of both cases studied.

Table 6. Cases studied: Organization Sustainability Framework Analysis

Issues considered in the case studies	Check list Simulation
Determination of the board commitment	<ul style="list-style-type: none"> (i) Sustainability is a board priority; (ii) Sustainability is integrated into the company's culture, mission, vision and values; (iii) Companies allocate resources for developing proactive management decisions under the sustainability principles; (iv) Sustainability is a principle in the company's objectives, strategies and the rest of practices and activities of the management system; (v) Companies use sustainability metrics to evaluate the organization's performance; (vi) Companies tie the compensation system to the sustainability performance; (vii) Sustainability issues are integrated in the internal training program for workers; (viii) Key stakeholders are involved in the assessment; (ix) Environmental, social and economic impacts are reported to stakeholders. (x) Companies periodically control the effectiveness of the sustainability management system and adopt a continual improvement approach; (xi) Companies promote an effective traceability system, and; (xii) Companies commit to making all activities of the company subject to an audit or external evaluation.
Corporate governance connection with sustainability.	<ul style="list-style-type: none"> (i) <i>Governance foundations.</i> The companies state their sustainability commitment in their missions and in the rest of elements that define and implement the rules of management, including in the management cycle. (ii) <i>Stakeholder engagement.</i> The companies ensure that stakeholders' views are encompassed in governance and management, encouraging the active participation of stakeholders at the highest level of the governance structure and promoting dialogue with stakeholders in the different management phases (planning, execution, monitoring and adaptation).

	<p>(iii) <i>Internal governance structure</i>. This structure shows a clear division of sustainability duties and responsibilities that are line with power hierarchy and incentive systems.</p> <p>(iv) <i>Tools for board's due diligence</i>. In both cases, the board of directors clearly defines its role in addressing sustainability issues to make their company more resilient and use the appropriate tools in order to integrate the environmental, social and economic risks in decision-making processes and in the management system.</p> <p>(v) <i>Sustainability information and communication</i>. The companies communicate information about sustainability, both internally and externally.</p> <p>(vi) <i>Governance mechanisms for the supply chain</i>. The companies set up mechanisms to minimize their exposure to opportunism and guarantee a sustainability management in the inter-organizational relationships throughout the supply chain.</p>
Knowledge about the objectives and scope of the Sustainability Assessment Framework	The companies have established the scope of the sustainability assessment, including direct and indirect environmental, social and economic impacts along the supply chain.
Positioning the organization within the supply chain	Both companies are clearly positioned as leaders within their respective products' supply chain, considering the full supply chain stages, including raw material acquisition, production and manufacturing, distribution, consumption, and end-of-life.
Organization awareness of its impacts throughout the lifecycle	Both companies list the impacts or potential impacts (direct and indirect) across the lifecycle that their activity generates.
Definition of the organizations' supply chain map	The two cases have elaborated a list of direct (tier 1) and indirect suppliers (beyond immediate tier 1 suppliers), their location and the connection with the organizational activity.
Identification of stakeholders	Both companies have identified their key stakeholders following a systematic methodology, and have prioritized them to ensure efficient stakeholder engagement and make a strategic use of resources.
Move forward in the evaluation process	The two cases have institutionalized a culture of continuous improvement, which implies increasingly demanding environmental, social and economic targets.
Plan for the sustainability strategy	(i) The companies have mapped the short, medium and long-term plans to achieve their sustainability vision, considering risks and opportunities;

	<p>(ii) The companies have identified the environmental, social and economic goals in order to make them more sustainable;</p> <p>(iii) The companies have applied stakeholder and expert knowledge to prioritize the goals and to define the action plan;</p> <p>(iv) The companies have developed a robust and consistent sustainability plan, that includes measurable targets and key performance and process indicators, and;</p> <p>(v) The companies have supported sustainability training programs and staff compensation schemes with sustainability variables.</p>
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3.5. Step 2: Sustainability Assessment Tool (SAT)

The aim of this step is to perform a comprehensive sustainability evaluation, using science-based metrics and tools (footprints, hotspots analysis and multi-criteria decision-making methods). The logic structure of this tools' system has been defined with the objective of supporting informed decisions with data on the organization's hotspots, on how to manage material impacts and on how to provide a synthetic sustainability indicator.

3.5.1. Phase 1: Footprints Tools

The footprint methodologies are a starting point to identify and measure environmental, social and economic impacts. A footprint could be defined as a tool which integrates a lifecycle approach and defines a comprehensive range of environmental, social or economic impact categories that could be directly related, not only to the most significant global challenges, but also to every potential hotspot that a company could manifest.

The framework offers footprint methodologies (from well-known initiatives or developed explicitly for this guide) to identify and measure environmental, social and economic impacts. Grounded on best practices and aligning efforts with key initiatives, such as the Organisational Environmental Footprint from the European Commission and the UNEP/SETAC methodology, as tools to measure the environmental and social impacts should be adopted. The Economic Footprint is a SMART Project proposal, based on different research and economic developments.

Environmental Footprint

The Organisational Environmental Footprint¹¹ has been tested using the three scenarios, previously defined. The SimaPro tool, with data provided by Ecoinvent V3.2, has been used as a source of quantitative data in the environmental dimension for both sectors. Ecoinvent offers lifecycle inventory (LCI) and lifecycle impact assessment (LCIA) results. As in the study of Muñoz-Torres et al. (2020)¹², lifecycle impacts were assessed based on ILCD 2011 Midpoint+ V1.10/ECJRC Global, equal weighting.

The case studies includes three information inputs for carrying out the suitability analysis of the Environmental Footprint:

- (i) The results of the 14 OEF impact categories that arise from each scenario. These results correspond to the mid-points of the OEF.
- (ii) The weighted results of the 14 OEF impact categories from each scenario with the aim of identifying the most relevant impact categories. This information will provide technical input to identify the hotspots in the following phase 'Hotspots Analysis Tool'.

¹¹ European Commission (2013) "2013/179/EU: Commission Recommendation of 9 April 2013 on the use of common methods to measure and communicate the life cycle environmental performance of products and organizations", Text with EEA relevance Available at: <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32013H0179> (Accessed on 25 February 2019)

¹² Muñoz-Torres et al. (2020) (as n.4 above)

- (iii) The cumulative impact contribution of each lifecycle phase to the overall impact by impact category. In the corresponding table, the impact categories have been ordered from the highest to the lowest level of significance of their impact. This information will provide technical input to identify the hotspots in the following phase 'Hotspots Analysis Tool'.

Social Footprint

The Social Footprint has been tested using the three scenarios previously defined. The SimaPro tool, with data provided by SHDB v2.1, has been used as a source of quantitative data in the social dimension for both sectors. The Social Hotspots Database (SHDB) is made up of country and sector-specific tables to help identify hotspots, as well as the concerned countries and sectors in the supply chains, based on potential social impacts. Twenty-two Social Themes Tables have been constructed by the database, which fall under five social categories (Labor Rights, Health & Safety, Human Rights, Governance and Community). SHDB_Ecoinvent_Hybrid_2017_v1_version84 assesses lifecycle impacts as a quantitative social impact related to production and consumption as a characterization model.

The case studies includes two data inputs for carrying out the suitability analysis of the Social Footprint:

- (i) The results of the 18 impact categories associated with 5 social categories that arise from each scenario. These results are presented in terms of points following the UNEP-SETAC method. Note that the points are only comparable for the impact categories that belong to the same social category.
- (ii) The weighted results of the 18 impact categories from each scenario with the aim of identifying the most relevant impact categories for each social category. This information will provide technical input to identify the hotspots in the following phase 'Hotspots Analysis Tool'. Given the points are not comparable for different social categories, it is also recommended

that expert knowledge for the analysis of relative importance among social categories be available.

- (iii) The cumulative contribution of each lifecycle phase to the overall impact, by each impact category. This result is a relevant technical input to identify the hotspots in the following phase 'Hotspots Analysis Tool'.

Economic Footprint

Businesses and industries could quantify their economic footprint by measuring their direct, indirect, and induced economic contributions (upstream and downstream in their supply chains and measuring positive and negative impacts), driving improvements along the value chain, at the international, national, state, county, and any other levels. The objective of the Economic Footprint is therefore to be aware of how economic and financial flows move, who in the supply chain extracts technological and financial rents; in which way funds are transferred around the world and how companies shift accounting profits to low-tax jurisdictions, and also to consider the wage inequalities along the supply chains.

The Economic Footprint of a company takes into account the key societal economic impacts of the organization. The principal set of indicators are connected to direct and indirect economic impacts (GRI 2011¹³) and the proposed categories that address these are: business survivorship; taxes (fiscal elusion); efficiency; compliance; employment, and; inequality within the company and along the supply chains.

Under these premises, this guide proposes different indicators, based on the different sources showed in column 3 and six economic impact categories as detailed in Table 7. These economic impacts overcome the limits of the primacy shareholder approach, integrating questions whose scope go beyond organizational boundaries, taking into account the economic contribution of the organization to other stakeholders such as actors of the supply chain, employees and society.

¹³ Global Reporting Initiative. (2011). Global reporting initiative G3.1 Guide

Table 7. Economic Footprint impact categories and indicators¹⁴

Impact Category	Impact Category Indicators	Source
Business Survivorship	<ul style="list-style-type: none"> Altman z-score 	Altman (2000)
Taxes (fiscal elusion)	<ul style="list-style-type: none"> Tax Rate= $1 - \sum(\text{effective tax rate/theoretic by country and product})$ 	(Alstadsæter, A. et. Al 2017)
Efficiency	<ul style="list-style-type: none"> Environmental value added/ unit investment Direct R&D intensity Indirect R&D intensity 	(ERIA, 2010)
Compliance (Non-compliance indicators)	<ul style="list-style-type: none"> Monetary value of significant fines; Total number of non-monetary sanctions for non-compliance with laws and regulations; Number of internal procedures related to non-conformities of the compliance management system that constitute a violation of the regulations or values of the organization; Number of external or internal claims related to compliance risks, and; Number of adverse or almost-non-compliances news of the organization, related to compliance risks. 	GRI (2011) and KPMG (2018)
Employment (direct and indirect)	<ul style="list-style-type: none"> Local Employment category modified 	T.A. Branca, M. Vannucci and V. Colla (2008)
Inequality (Income or benefit distribution along supply chain)	<ul style="list-style-type: none"> Gini index modified 	OCDE 2019

Source: Own creation

¹⁴ Altman, E. I. (2000). Predicting financial distress of companies: revisiting the Z-score and ZETA models. Stern School of Business, New York University, 9-12.

Alstadsæter, A., Jacob, M., & Michaely, R. (2017). Do dividend taxes affect corporate investment? Journal of Public Economics, 151, 74-83.

ERIA (2011): Sustainability Assessment methodology for Biomass Energy Utilization for Small and Large Scale Initiatives: Lessons Learned from Pilot Studies in Selected East Asian Countries. ERIA Research Project Report 2010, No. 22. Available at: <http://www.eria.org/publications/sustainability-assessment-methodology-for-biomass-energy-utilization-for-small-and-large-scale-initiatives-lessons-learned-from-pilot-studies-in-selected-east-asian-count/> (Last accessed on 17/05/2019)

Global Reporting Initiative. (2011). Global reporting initiative G3.1 Guide

KPMG (2018): Claves sistémicas en Compliance. Serie Compliance avanzado- 6. Available at: <https://assets.kpmg/content/dam/kpmg/es/pdf/2018/05/claves-sistematicas-compliance.pdf> (Last accessed on 17/05/2019)

Branca, T. A., Vannucci, M., & Colla, V. (2009). A KPI for Local Community Impact of the ULCOS technologies. Revue de Métallurgie, 106(9), 373-381.

OECD (2019), Income inequality (indicator). doi: 10.1787/459aa7f1-en (Accessed on 17 May 2019)

However, the current state of research databases does not allow us to test this economic footprint according to the impact categories determined as relevant for this end, neither regarding the scope nor the profile of companies that should be assessed. Current economic databases containing information on companies mainly focus on listed companies, but usually, companies in the different stages of the lifecycle are also small and medium size companies.

3.5.1.1. Textile sector case study: Cotton-made t-shirt company

This section includes the results of the testing process of the Environmental and Social Footprint in a fictitious company that operates in the textile sector and produces only one product, cotton-made t-shirts. The Environmental and Social Footprint have been estimated using the three scenarios previously defined. Note that the current state of databases does not allow us to test the Economic Footprint.

Environmental footprint

Table 8 displays the 14 impact results associated with the cotton-made T-shirt lifecycle. The analysis has been carried out using the three scenarios previously defined¹⁵.

Figure 6 shows the weighted results of the impact categories. The weighed results enable us to identify the most important ones. For instance, analysing the results in the textile company, four impact categories could be identified as the most important ones: i) “water resource depletion”, ii) “human toxicity-cancer effects”, iii) “freshwater ecotoxicity” and iv) “human toxicity-non-cancer effects”.

In addition, this analysis also shows the differences within impact results depending on the scenarios. For example, Figure 6 shows differences between scenarios 1-2 vs scenario 3 in two categories: "water resource depletion" and "ionizing radiation".

¹⁵ Muñoz-Torres et al. (2020) (as n.4 above)

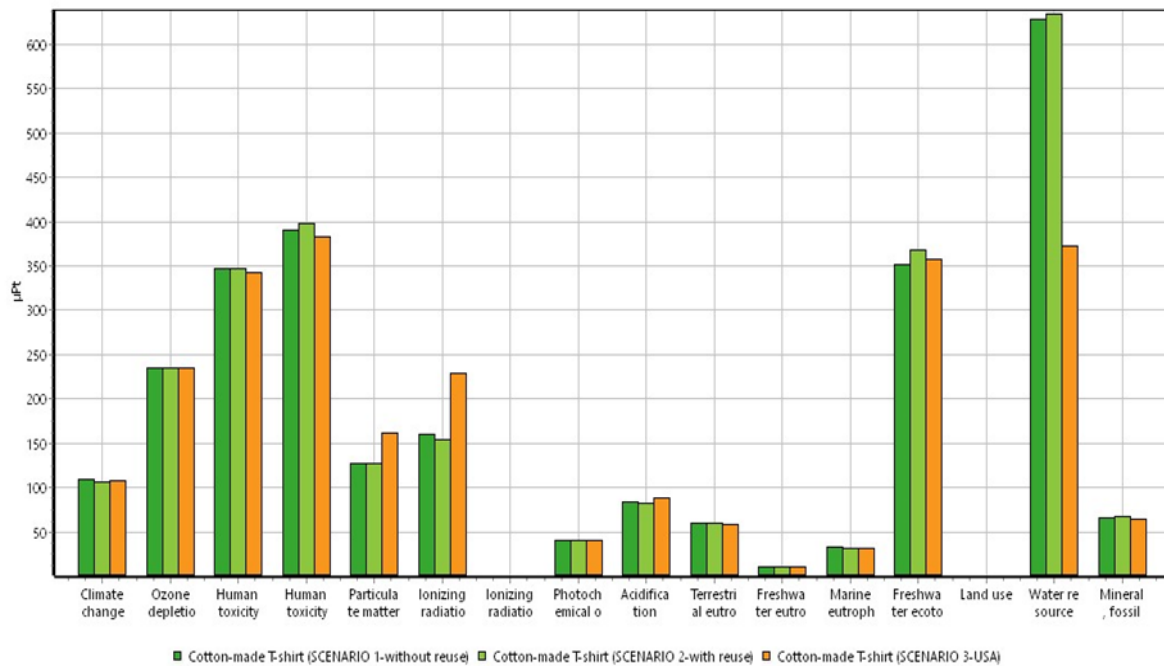
Table 8. Environmental impact analysis results considering a cotton-made t-shirt lifecycle by scenarios

Impact categories	Units	Cotton-made T-shirt (Scenario 1- without reuse)	Cotton-made T-shirt (Scenario 2 - with reuse)	Cotton-made T-shirt (Scenario 3 - THE USA)
Climate change	kg CO2 eq	11.5087	11.2518	11.3871
Ozone depletion	kg CFC-11 eq	4.30E-05	4.29E-05	4.31E-05
Human toxicity - cancer effects	CTUh	7.27E-08	7.40E-08	7.13E-08
Human toxicity- non-cancer effects	CTUh	8.07E-07	8.07E-07	7.97E-07
Particulate matter	kg PM2.5 eq	0.0096	0.0096	0.0123
Ionizing radiation HHE	kBq U235 eq	0.5809	0.5584	0.8296
Photochemical ozone formation	kg NMVOC eq	0.0276	0.0275	0.0273
Acidification	molc H+ eq	0.0701	0.0697	0.0748
Terrestrial eutrophication	molc N eq	0.1472	0.1469	0.1444
Freshwater eutrophication	kg P eq	0.0010	0.0010	0.0010
Freshwater ecotoxicity	CTUe	19.7498	20.6068	20.0737
Water resource depletion	m3 water eq	0.6496	0.6556	0.3854
Mineral, fossil & res. depletion	kg Sb eq	0.0002	0.0002	0.0002
Land use	kg C deficit	41.7968	41.6876	41.2143

Source: Muñoz-Torres et al. (2020)¹⁶

¹⁶ Muñoz-Torres et al. (2020) (as n.4 above)

Figure 6. Textile industry environmental impact categories by scenarios



Source: Muñoz-Torres et al. (2020)¹⁷

Table 9 allows us to identify the cumulative impact contribution of each lifecycle phase to the overall impact by impact category. The results presented in the table have been calculated based on “Scenario 2”, since it shows the most complete framework, including a low-income country for the end life of the product.

Table 9 reflects that 50% of cumulative impact contribution to any impact category is reached in the two first phases of the product lifecycle. The high percentage achieved in the first phase “raw material acquisition” in the cases of “water resource depletion” (95.5%), “land use” (92.0%) and “Ecotoxicity-fresh water” (82.2%) impact categories is strongly evident. For a further and in-depth discussion of these results, see Muñoz-Torres et al. (2020)¹⁸.

¹⁷ Muñoz-Torres et al. (2020) (as n.4 above)

¹⁸ Muñoz-Torres et al. (2020) (as n.4 above)

Table 9. Cumulative environmental impact contribution of each lifecycle phase of a cotton-made t-shirt

		Lifecycle Phases				
Impact Category		Raw material acquisition	Fabric production	Garment Manufacturing	Consumer Use	End of the life
1	Water resource depletion	95.5	93.0*	92.9*	92.9*	100
2	Human toxicity - cancer effects	31.7	83.0	84.0	85.0	100
3	Ecotoxicity – fresh water	82.2	93.1	93.3	93.9	100
4	Human toxicity – non-cancer effects	26.6	85.9	86.3	86.4	100
5	Ozone depletion	0.31	99.6	99.6	99.7	100
6	Ionizing radiation – human health effects	9.6	76.9	79.4	80.3	100
7	Particulate matter/ respiratory inorganics	15.7	92.2	95.0	95.7	100
8	Climate change	-1.64	72.6	74.7	75.3	100
9	Acidification	26.9	88.0	92.2	93.0	100
10	Mineral fossil and resource depletion	22.2	87.4	87.6	87.7	100
11	Terrestrial eutrophication	45.8	88.5	92.4	93.4	100
12	Photochemical ozone formation	20.5	83.3	88.8	90.6	100
13	Freshwater eutrophication	27.2	70.5	71.6	71.6	100
14	Land Use	92.0	97.9	98.0	98.2	100

Note: Values expressed in percentages. Numbers in bold represent the lifecycle phase that reach 50% of cumulative impact contribution to any impact category.

*The decrease with respect to the previous lifecycle phase could be accounted for in this specific case by the use of a renewable electric energy source which has resulted in a reduction in this impact category.

Source: Muñoz-Torres et al. (2020)¹⁹

¹⁹ Muñoz-Torres et al. (2020) (as n.4 above)

Social footprint

Table 10 displays the 18 impact categories results associated with the cotton-made T-shirt lifecycle. The analysis has been carried out using the three scenarios previously defined.

Table 10. Social impact analysis results considering a cotton-made t-shirt lifecycle by scenarios

Social categories	Impact categories	Cotton-made T-shirt (Scenario 1- without reuse)	Cotton-made T-shirt (Scenario 2 - with reuse)	Cotton-made T-shirt (Scenario 3 - THE USA)
Labor rights and decent work	Child Labor	13.62	13.62	9.06
	Forced Labor	14.23	14.21	9.01
	Excessive Working Time	10.03	10.02	7.09
	Wage Assessment	38.32	38.24	27.99
	Poverty	14.92	15.19	9.94
	Migrant Labor	16.49	16.45	11.09
	Collective Bargaining	40.13	40.02	33.34
	Social Benefits	11.57	11.56	9.60
Health and safety	Injuries and Fatalities	22.75	22.72	15.32
	Toxics and Hazards	35.73	35.62	25.11
Human rights	Indigenous Rights	5.59	5.58	2.93
	Gender Equity	12.90	12.88	8.18
	High Conflict	17.40	17.37	11.62
Governance	Legal System	13.60	13.57	10.25
	Corruption	17.31	17.27	12.41
Community infrastructure	Drinking Water	4.42	4.42	3.49
	Improved Sanitation	9.60	9.58	6.60
	Hospital Beds	10.38	10.37	7.45

Source: Own creation based on SimaPro simulations (Simulation data: June 2019)

Figures 7-11 show the weighted results of the impact categories by social category. The weighed results allow us to identify the most important ones in each social category. Analysing the results in 'Labor rights and decent work' social category, two impact categories could be identified as the most important ones: 'collective bargaining' and 'wage assessment'. For the 'Health and safety' category it is 'Toxics and Hazards'; for the respect to 'Human Rights' category it is 'High Conflicts'; for the 'Governance' category it is 'corruption', and; for the 'Community infrastructure' category it is 'Hospital beds'.

In addition, this analysis also shows the differences in impact results depending on the scenarios. In this case, scenario 3 shows better results in all the social categories analyzed.

Figure 7. Textile industry 'Labor rights and decent work' category by scenarios

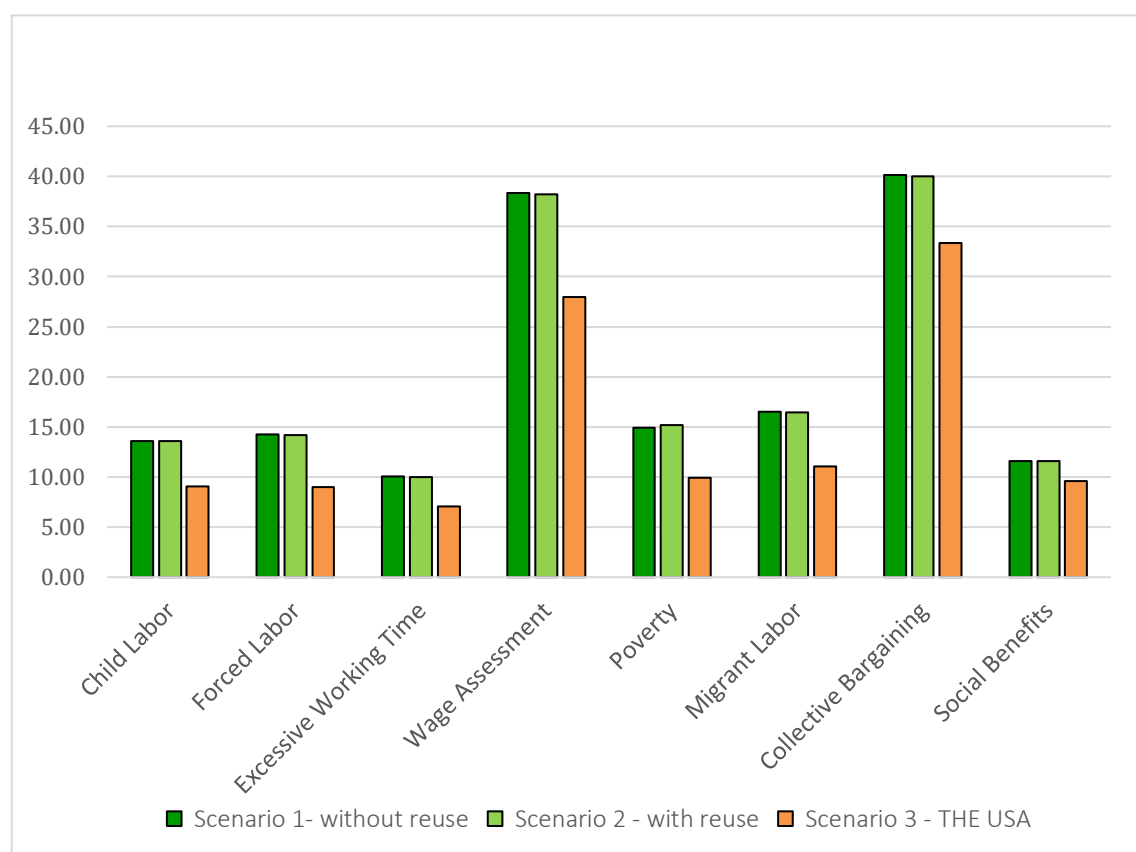


Figure 8. Textile industry 'Health and safety' category by scenarios

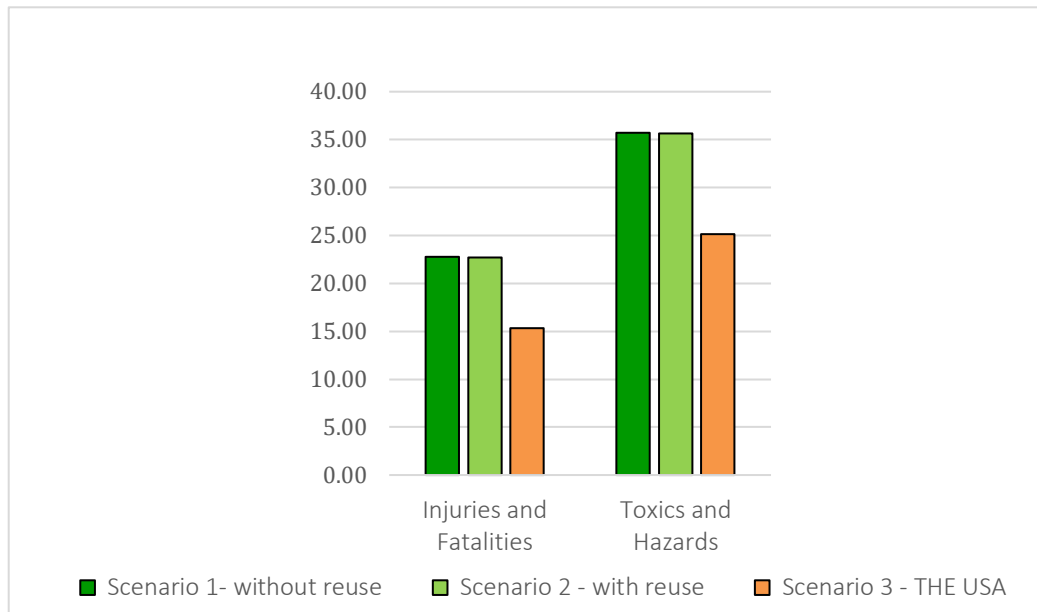


Figure 9. Textile industry 'Human Rights' category by scenarios



Figure 10. Textile industry 'Governance' category by scenarios

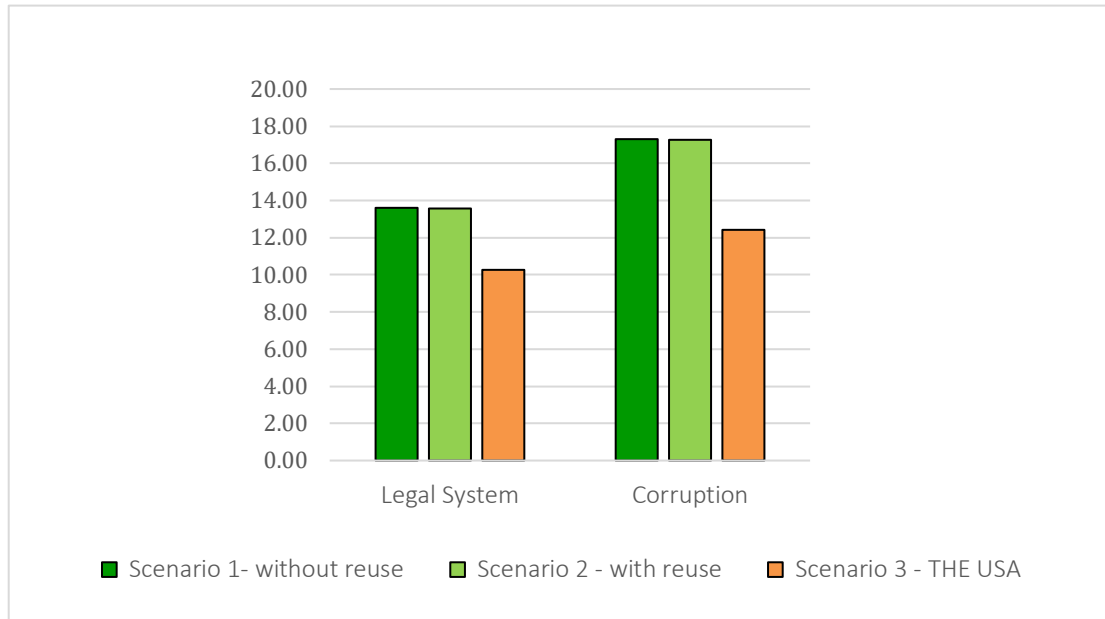


Figure 11. Textile industry 'Community infrastructure' category by scenarios

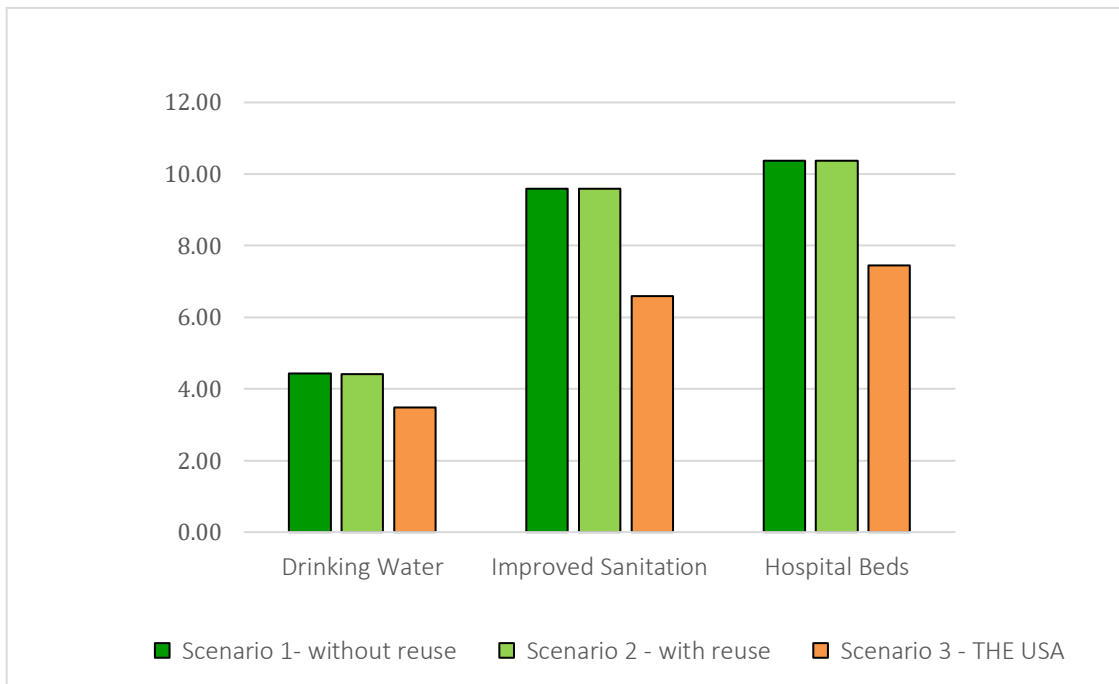


Table 11 allows us to identify the cumulative impact contribution of each lifecycle phase to the overall impact by social impact category. The results presented in the table have been calculated based on “Scenario 2”, since it shows the most complete framework including in a low-income country for the end life of the product. Table 11 reflects that 50% of cumulative impact contribution to any impact category is reached in the first two phases of the product lifecycle. The high percentage achieved in the first phase “raw material acquisition” in the cases of ‘High Conflict’ (51.75%) is strongly evident. It is also noticeable that in the phase ‘Fabric production’, the cumulative impact contribution to the impact categories ‘Wage Assessment’, ‘Child Labor’, ‘Toxics and Hazards’, ‘Injuries and Fatalities’, ‘High Conflict’, ‘Gender Equity’ and ‘Indigenous Rights’ exceeds 80%.

Table 11. Cumulative social impact contribution of each lifecycle phase of a cotton-made t-shirt

Social Category	Impact Category	Lifecycle Phases				
		Raw material acquisition	Fabric production	Garment Manufacturing	Consumer Use	End of the life
Labor rights and decent work	Collective Bargaining	34.00	77.71	95.96	98.98	100
	Wage Assessment	38.39	82.23	95.92	99.18	100
	Migrant Labor	32.02	77.89	96.42	99.20	100
	Poverty	29.18	79.21	95.80	99.15	100
	Forced Labor	34.93	79.85	93.97	97.21	100
	Child Labor	34.08	82.30	96.02	99.25	100
	Social Benefits	22.90	75.29	95.50	99.14	100
	Excessive Working Time	27.67	75.93	95.73	99.02	100
Health and safety	Toxics and Hazards	37.88	83.25	95.62	99.06	100
	Injuries and Fatalities	30.91	81.45	95.65	99.22	100
Human rights	High Conflict	51.75	93.09	95.38	98.95	100

	Gender Equity	38.26	83.16	96.14	99.15	100
	Indigenous Rights	34.86	80.97	95.99	99.16	100
Governance	Corruption	27.05	77.37	95.46	99.07	100
	Legal System	29.28	79.69	95.43	99.12	100
Community infrastructure	Hospital Beds	26.98	74.81	95.34	98.93	100
	Improved Sanitation	32.85	79.61	95.80	99.12	100
	Drinking Water	31.24	79.12	95.91	99.08	100

Note: Values expressed in percentages. Numbers in bold represent the lifecycle phase that reach 50% of cumulative impact contribution to any impact category.

Source: Own creation based on SimaPro simulation using “Scenario 2” (Simulation data: September 2019)

3.5.1.2. Mobile phone case study: Mobile phone company

This section includes the results of the testing process of the Environmental and Social Footprint in a fictitious company that produces only one product, mobile phones. The Environmental and Social Footprint has been estimated using the three scenarios defined previously defined. Note that the current state of databases does not allow us to test the Economic Footprint.

Environmental footprint: Mobile phone company

Table 12 displays the 14 impact results associated with a mobile phone lifecycle. The analysis has been carried out using the three scenarios previously defined.

Figure 12 shows the weighted results of the impact categories. The weighed results allow us to identify the most important ones. For example, analysing the results in the mobile phone producer company, ‘Mineral, fossil and resource depletion’ impact category could be identified as the most important one. Focusing on Scenarios 1 and 2, other relevant impacts are: ‘Human toxicity non-cancer effects’, ‘Particulate matter’ and ‘Freshwater eutrophication’.

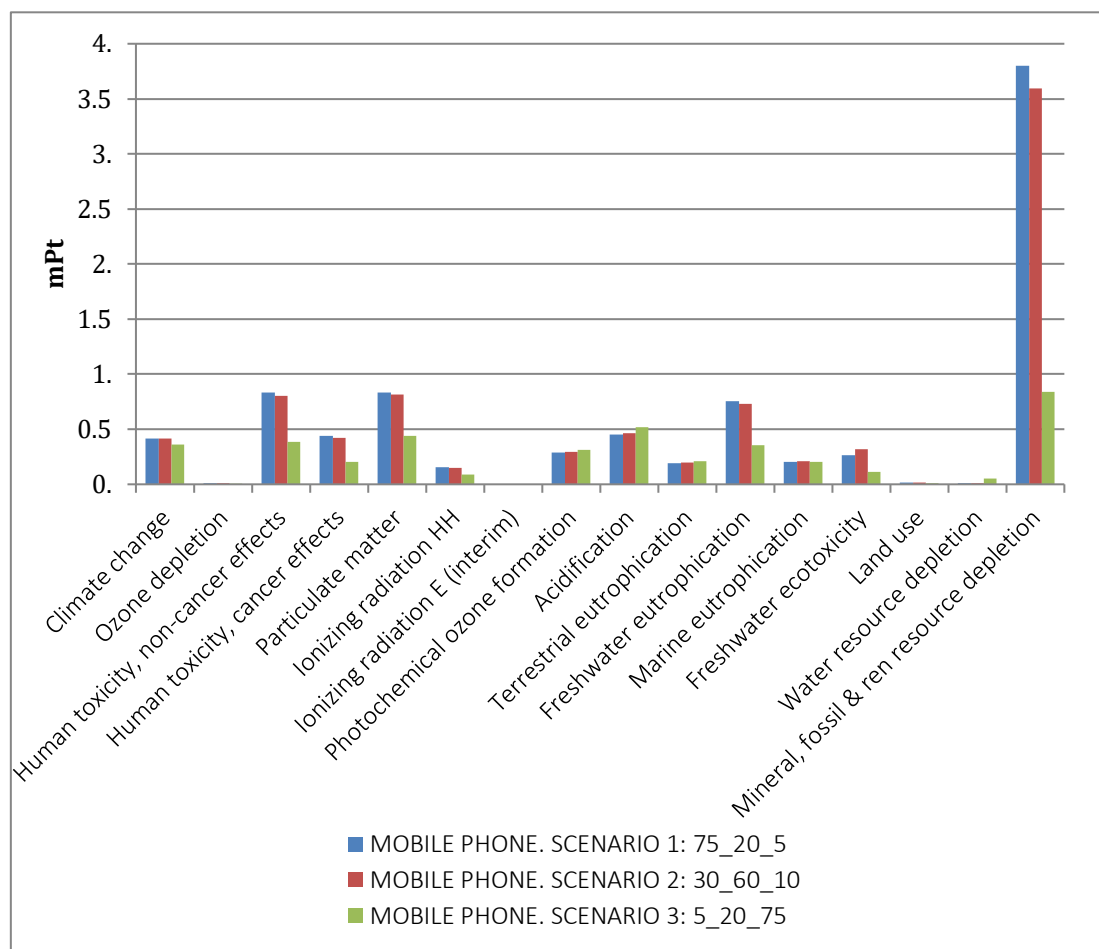
Table 12. Environmental impact analysis results considering a mobile phone lifecycle by scenarios

Impact categories	Units	Scenario 1: 75-20-5	Scenario 2: 30-60-10	Scenario 3: 5-20-75
Climate change	kg CO2 eq	57.4	57.7	50.2
Ozone depletion	kg CFC-11 eq	3.20E-06	3.14E-06	1.88E-06
Human toxicity - cancer effects	CTUh	6.65E-06	6.44E-06	3.08E-06
Human toxicity- non-cancer effects	CTUh	2.40E-07	2.34E-07	1.12E-07
Particulate matter	kg PM2.5 eq	0.0476	0.0466	0.0252
Ionizing radiation HHE	kBq U235 eq	2.61	2.54	1.51
Photochemical ozone formation	kg NMVOC eq	0.137	0.14	0.148
Acidification	molc H+ eq	0.322	0.33	0.368
Terrestrial eutrophication	molc N eq	0.506	0.516	0.555
Freshwater eutrophication	kg P eq	0.0168	0.0162	0.00784
Freshwater ecotoxicity	CTUe	35	41.8	14.8
Water resource depletion	m3 water eq	0.00887	0.0129	0.0609
Mineral, fossil & res. depletion	kg Sb eq	0.00576	0.00544	0.00127
Land use	kg C deficit	17.6	17.3	11.2

Source: Own creation based on SimaPro simulations (Simulation data: September 2019)

Moreover, this analysis also shows the differences in terms of impact results depending on the scenarios. For example, Figure 12 shows large differences in terms of impact results of the “Mineral, fossil and resource depletion” category between scenarios 1-2 and scenario 3.

Figure 12. Mobile phone environmental impact categories by scenarios



Source: SimaPro simulations (Simulation data: September 2019)

Table 13 allows us to identify the cumulative impact contribution of each lifecycle phase to the overall impact, by impact category. In this analysis, it three phases have been considered: 'Production', 'Consumer Use' and 'End of life'. The Production phase has been defined aggregating the phases that go from 'Raw Material Acquisition' to 'Transportation/Distribution' previously included in Figure 3. This aggregation process is due to current database limitations, since the complexity of the mobile phone has not been integrated yet in the database available to analyse the impact along the lifecycle of this product.

The results presented in Table 13 have been calculated based on "Scenario 1", since it has been designed to show the closer scenario to the current situation of the sector. Even though it is evident that the main cumulative impact contribution to any impact category

is reached in the Production phase, it is also noticeable in the contribution of the consumer use phase to the 'Climate Change' and 'Ionizing radiation – human health effects' impact categories.

Table 13. Cumulative environmental impact contribution of each lifecycle phase of a mobile phone

Impact Category		Lifecycle Phases		
		Production	Consumer Use	End of the life
1	Mineral fossil and resource depletion	104.06	105.06	100*
2	Human toxicity - cancer effects	93.00	103.40	100*
3	Particulate matter/ respiratory inorganics	97.87	102.48	100*
4	Freshwater eutrophication	91.40	103.69	100*
5	Acidification	88.44	98.10	100
6	Human toxicity – non- cancer effects	85.15	103.13	100*
7	Climate change	70.70	99.78	100
8	Photochemical ozone formation	86.15	98.19	100
9	Ecotoxicity – fresh water	86.94	92.26	100
10	Terrestrial eutrophication	85.97	98.25	100
11	Ionizing radiation – human health effects	71.99	102.70	100*
12	Land Use	75.81	102.14	100*
13	Ozone depletion	98.77	100.03	100*
14	Water resource depletion	-805.45*	56.41	100

Note: Values expressed in percentages. Numbers in bold represent the lifecycle phase that reach 50% of cumulative impact contribution to any impact category.

*The decrease with respect to the previous lifecycle phase could be accounted for in this specific case by reuse percentage (5%), that produces light impact compensations. For water resource depletion, the use of high voltage electricity produced from natural gas and from heat and power cogeneration produces impact compensation.

Source: Own creation based on SimaPro simulation using “Scenario 1” (Simulation data: September 2019)

Social footprint: Mobile phone company

Table 14 displays the 18 impact categories results associated with the mobile phone lifecycle. The analysis has been carried out using the three scenarios previously defined.

Table 14. Social impact analysis results considering a mobile phone lifecycle by scenarios

Social categories	Impact categories	Mobile Phone (Scenario 1: 75-20-5)	Mobile Phone (Scenario 2: 30-60-10)	Mobile Phone (Scenario 3: 5-20-75)
Labor rights and decent work	Child Labor	21.60	21.90	22.40
	Forced Labor	24.00	23.40	14.20
	Excessive Working Time	18.40	17.90	10.40
	Wage Assessment	103.00	102.00	69.60
	Poverty	26.30	26.00	19.60
	Migrant Labor	48.40	47.30	32.90
	Collective Bargaining	127.00	126.00	89.00
	Social Benefits	20.90	17.40	11.60
Health and safety	Injuries and Fatalities	36.80	35.90	21.50
	Toxics and Hazards	108.00	107.00	73.30
Human rights	Indigenous Rights	9.39	9.68	9.63
	Gender Equity	21.70	21.10	12.00
	High Conflict	30.90	30.50	20.40
Governance	Legal System	34.30	33.80	23.50
	Corruption	48.80	48.50	40.10
Community infrastructure	Drinking Water	8.33	8.21	6.29
	Improved Sanitation	18.20	17.80	11.50
	Hospital Beds	17.30	17.40	13.90

Source: Own creation based on SimaPro simulations (Simulation data: Juny 2019)

Figures 13-17 show the weighted results of the impact categories by social category. The weighed results allow us to identify the most important ones in each social category. Analysing the results in the ‘Labor rights and decent work’ social category, two impact categories could be identified as the most important ones: ‘Collective bargaining’ and ‘Wage assessment’; regarding ‘Health and safety’ it is ‘Toxics and hazards’; ‘Human rights’ it is ‘High conflicts’; ‘Governance’ it is ‘Corruption’; ‘Community infrastructure’ it is ‘Hospital beds’ for the scenario-3 and ‘Improved sanitation’ for the scenario 1-2.

In addition, this analysis also shows the differences in the impact results depending on the scenarios. In this case, scenario 3 shows better results in all the social categories analyzed.

Figure 13. Mobile phone industry ‘Labor rights and decent work’ category by scenarios

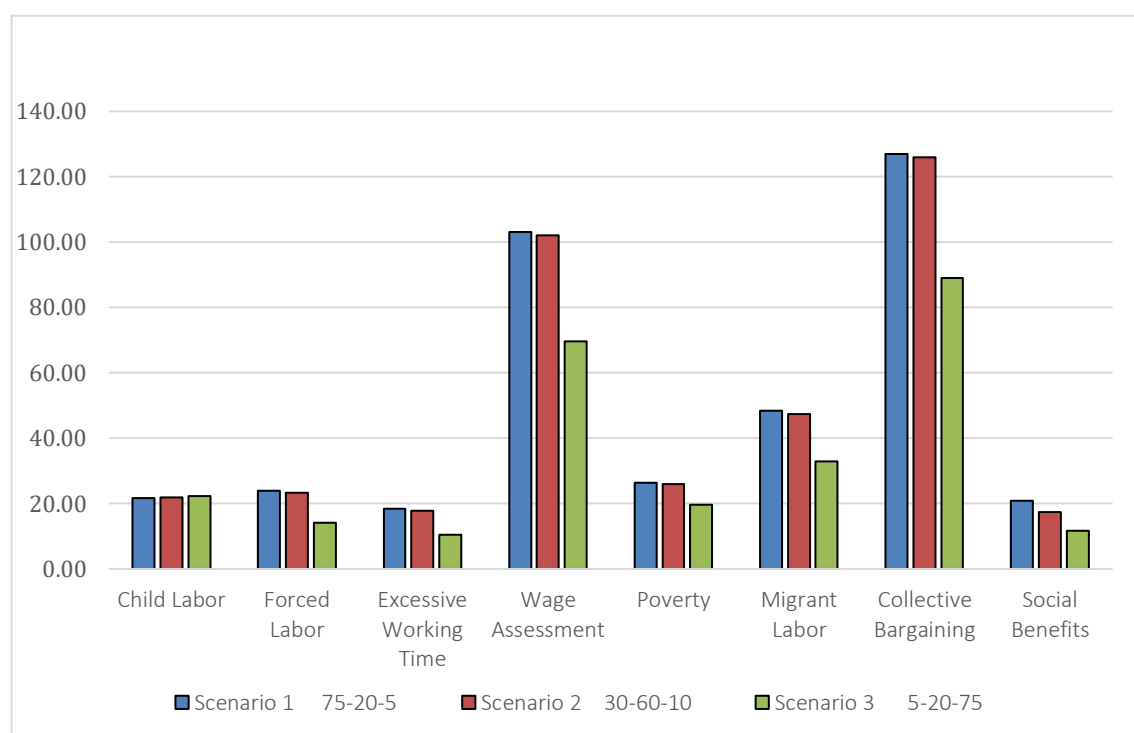


Figure 14. Mobile Phone industry 'Health and safety' category by scenarios

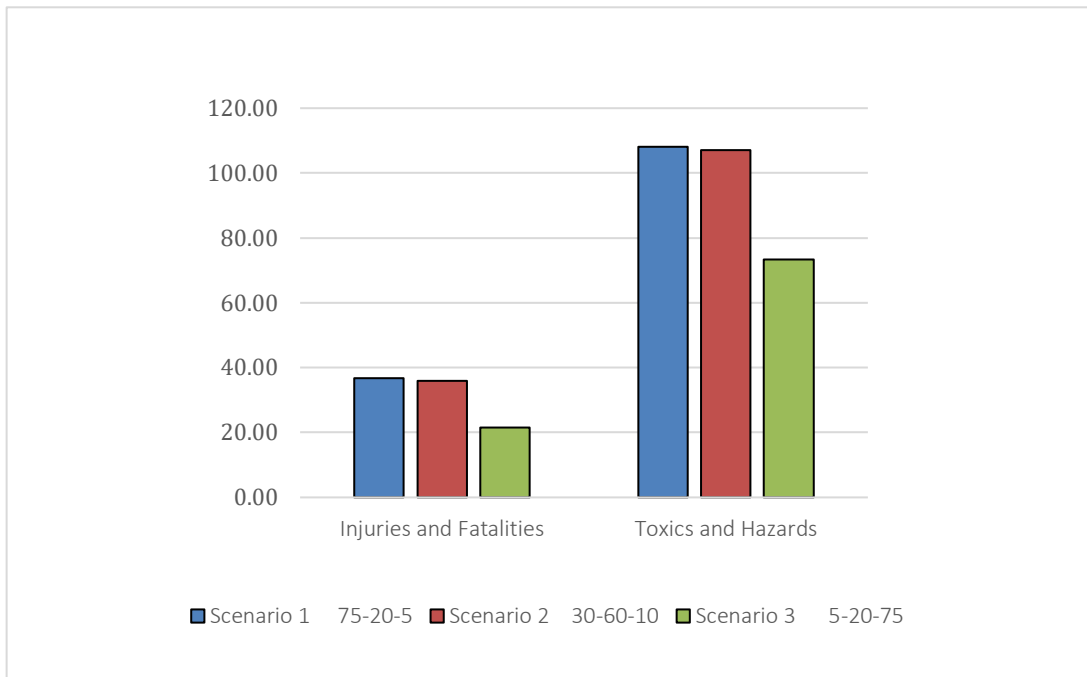


Figure 15. Mobile Phone industry 'Human Rights' category by scenarios

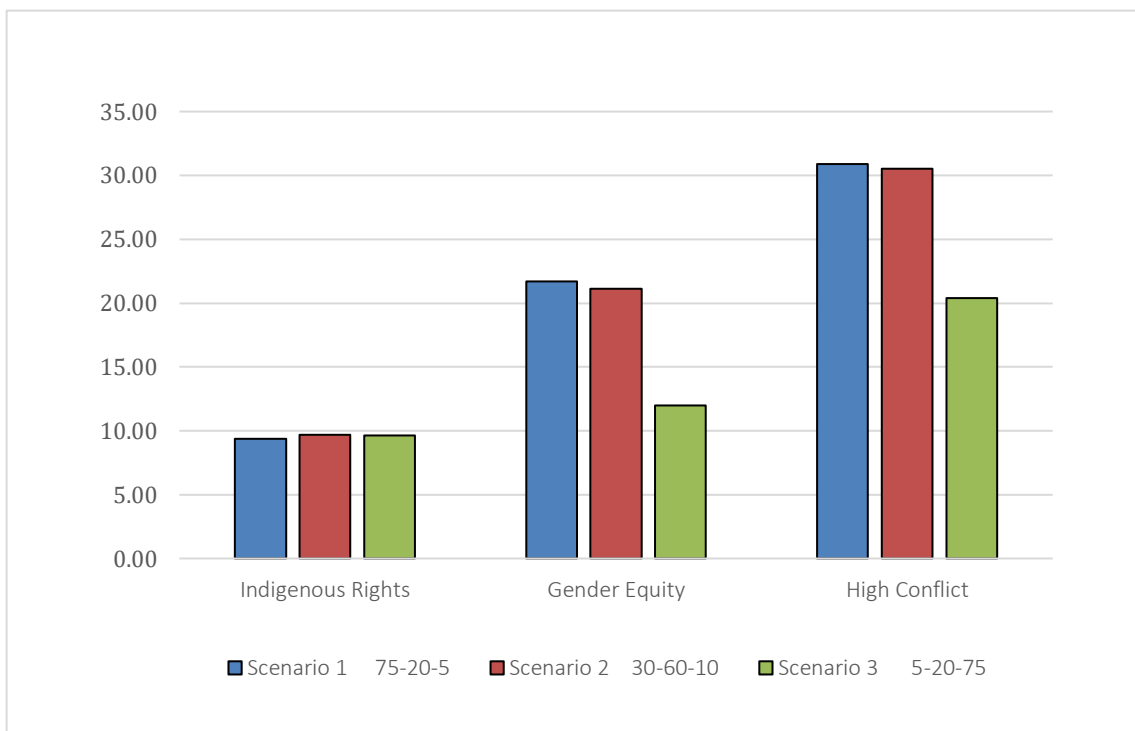


Figure 16. Mobile Phone industry 'Governance' category by scenarios

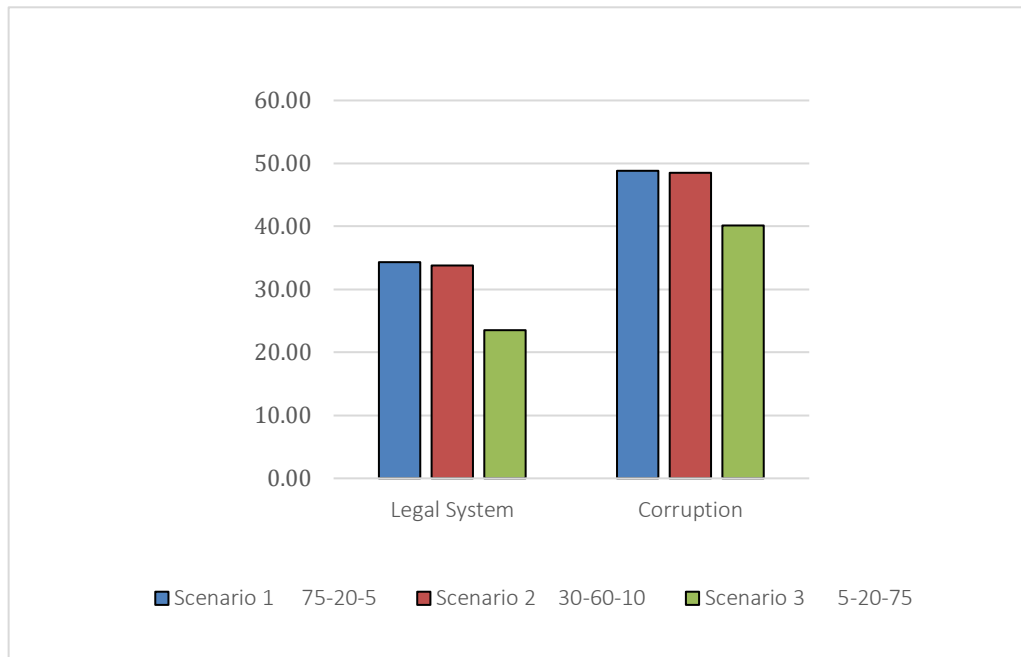


Figure 17. Mobile Phone industry 'Community infrastructure' category by scenarios

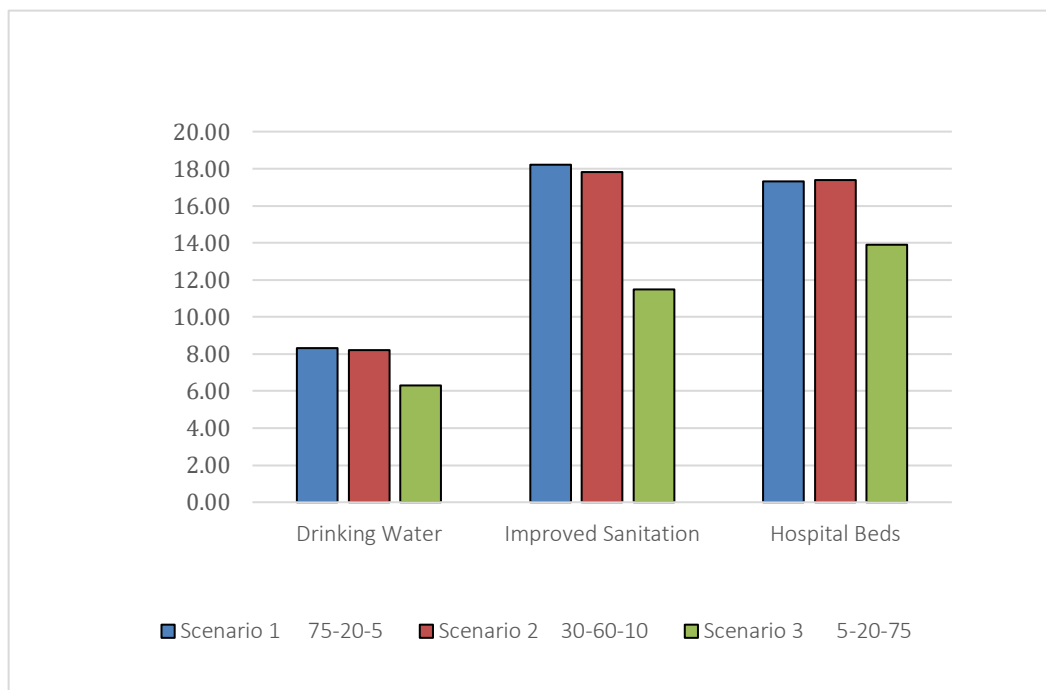


Table 15 allows us to identify the cumulative impact contribution of each lifecycle phase to the overall impact by social impact category. The results presented in the table have

been calculated based on “Scenario 1”, since it has been designed to show the closer scenario to the current reality of the sector. Even though it is evident that more than the 50% of the cumulative impact contribution to any impact category is reached in the Production phase, it is also noticeable in the contribution of the consumer use phase to the ‘Collective bargaining’, ‘Wage Assessment’, ‘Migrant Labor’, ‘Toxics and Hazards’ and ‘Corruption’ impact categories. This could be explained by the social impacts related to the electric consumption in the consumer phase.

Table 15. Cumulative social impact contribution of each lifecycle phase of a mobile phone

Social Category	Impact Category	Lifecycle Phases		
		Production	Consumer Use	End of the life
Labor rights and decent work	Collective Bargaining	55.66	101.63	100.00*
	Wage Assessment	56.37	102.03	100.00*
	Migrant Labor	54.30	102.22	100.00*
	Poverty	83.56	101.60	100.00*
	Forced Labor	83.45	102.80	100.00*
	Child Labor	80.90	99.06	100.00
	Social Benefits	83.34	102.52	100.00*
	Excessive Working Time	82.71	102.92	100.00*
Health and safety	Toxics and Hazards	56.98	101.65	100.00*
	Injuries and Fatalities	82.28	102.71	100.00*
Human rights	High Conflict	85.44	101.93	100.00*
	Gender Equity	83.55	102.95	100.00*
	Indigenous Rights	85.01	98.40	100.00
Governance	Corruption	52.09	100.95	100.00*
	Legal System	64.43	101.81	100.00*
Community infrastructure	Improved Sanitation	81.49	102.49	100.00*
	Hospital Beds	88.70	100.60	100.00*
	Drinking Water	89.21	101.57	100.00*

Note: Values expressed in percentages. Numbers in bold represent the lifecycle phase that reach 50% of cumulative impact contribution to any impact category.

Source: Own creation based on SimaPro simulation using “Scenario 1” (Simulation data: September 2019)

3.5.2. Phase 2: Hotspots Analysis Tool

The critical points of the organization under evaluation are determined. These hotspots are obtained after the first evaluation of the organization and they are kept active until their correction or suppression. To carry out this phase, the UNEP (2017) “Hotspots Analysis Overarching Methodological Framework and guidance for product and sector level application” should be considered.

Following UNEP (2017),²⁰ a hotspot could be defined as a lifecycle stage, process or elementary flow which accounts for a significant proportion of the impact of the functional unit. To carry out this phase, the methodology of UNEP (2017) hotspots analysis should be considered. This method allows users to perform different actions connected to hotspots inquiry. To that end, the subsequent steps should be followed:

Step 1. Define goal and scope. Under this step, organizations should align the purpose of the hotspots analysis with the Sustainability Assessment Framework phase 1: Organization sustainability framework analysis, whereby the most relevant impact categories are identified in the environmental, social and economic footprints, the boundaries of the analysis, the resources required and the approach to stakeholder engagement.

Step 2. Gather data, seek expert advice. In this phase, organizations have to collect, organize and analyze data from Sustainability Assessment Framework phase 2: Footprints tools.

Step 3. Identify and validate hotspots. Under this step, the hotspots associated with the unit of analysis should be identified. Considering the technical information of the previous step and the expert knowledge of the project team or working group – that should hold regular formal and informal meetings to define the scope of each impact on the different

²⁰ United Nations Environment Programme (2017): Hotspots Analysis An overarching methodological framework and guidance for product and sector level application. Available at: <https://www.lifecycleinitiative.org/new-hotspots-analysis-methodological-framework-and-guidance/> (Last accessed on 4/11/2019)

phases of the lifecycle – a consensus on the environmental, social and economic footprints impacts considered as critical points should be achieved.

The criteria applied for identifying the sectoral hotspots follow UNEP (2017)²¹ and the Guidance for the implementation of the EU PEF during the Environmental Footprint pilot phase (European Commission, 2016),²² where hotspots are elementary flows ‘cumulatively contributing at least 50% to any impact category’ before normalization and weighting.

The following subsections show the three key methodological steps in Hotspots Analysis and their associated key actions for both case studies. In this ‘Hotspots Analysis Tool’, the qualitative analysis (Step 3. Identify and validate hotspots) should be carried out by experts and stakeholders on the basis of the technical results obtained in previous phases of the SAF. As, in parallel, WP3 and WP4 developed its own hotspots analysis for both case studies included in this testing process, their outputs are also included in the simulated step of identification and validation of textile and mobile phone hotspots.

3.5.2.1. Hotspots analysis in a cotton-made t-shirt Company

Table 16 shows the three key methodological steps in Hotspots Analysis connected with key actions for their application in a cotton-made t-shirt Company. The goal is to identify the lifecycle stage which accounts for a significant proportion of the environmental and social impact of the t-shirt in those previously identified as priority aspects. As it was above mentioned, we will integrate two parallel works based on a cotton-made t-shirt: i) WP5 technical and science-based footprints impact categories study, and ii) WP3 sustainability hotspots analysis.

²¹ United Nations Environment Programme (2017): Hotspots Analysis An overarching methodological framework and guidance for product and sector level application. Available at: <https://www.lifecycleinitiative.org/new-hotspots-analysis-methodological-framework-andguidance/> (Last accessed on 17/05/2019)

²² European Commission (2016) “Product Environmental Footprint Pilot Guidance for the implementation of the EU Product Environmental Footprint (PEF) during the Environmental Footprint (EF) pilot phase”. Version 5.2 – February 2016. Available at: http://ec.europa.eu/environment/eussd/smgp/pdf/Guidance_products.pdf (Accessed on 25 February 2019)

Regarding the definition of goal and scope and for case study purposes, WP5 designed three scenarios presented in section 2 of this deliverable. Each of these scenarios was defined considering its own boundaries and hypotheses of the textile case study, that can be summarized as: i) cotton-made t-shirts with a global lifecycle without reuse, ii) cotton-made t-shirts with a global lifecycle with a reuse phase as second-hand items of clothing, and iii) cotton t-shirts with a local lifecycle (USA). The application of the Organization Sustainability Framework Analysis (Step 1 of the SAF) and the use of Environmental and Social footprint tools (Step 2 phase 1 of the SAF), provides a science-based battery of potential environmental and social impacts, whose scope is homogeneously defined by the Organisational Environmental Footprint from the European Commission and the UNEP/SETAC methodology respectively. In addition, in a SMART project context, expert knowledge from WP3 is also added through D3.1, which explored the hotspots analysis of a t-shirt and a pair of jeans based on a review of existing academic and grey literature, interviews and discussions with stakeholders.

Next step concerns the gathering of data and seek of expert advice. In this sense, the SAF defined by WP5 uses the science-based results of the quantitative analysis obtained after the application of the abovementioned environmental and social footprint methodologies over the different cotton-made t-shirt scenarios. These results regards both the most relevant social and environmental impact categories and the lifecycle stages which account for a significant proportion of those priority aspects (see section 3.5.1.1. for detailed results). As in the previous step of this SAF hotspots analysis tool, and in a SMART project context, the main results obtained from the qualitative analysis carried out focusing on the severe impacts of t-shirt provided by WP3 in deliverable D3.1. and D3.3., are also integrated.

**Table 16: Step 2 Phase 2 application. Hotspots Analysis Tool in the Cotton-made t-shirt
Company case study**

Issues considered	Application following the Sustainability Assessment Framework	Connection with WP3 process and results
1. Define goal and scope	Three scenarios defined for case study purposes. Analysis carried out based on technical and science-based methodologies defined in Step 2 phase 1 of the SAF (environmental and social footprints impact categories).	Deliverable D3.1: hotspots analysis of a t-shirt based on a review of existing academic and grey literature, interviews and discussions with stakeholders.
2. Gather data, seek expert advice	Science-based results of the quantitative analysis included in Tables 8-9 and Figure 6 for the environmental impacts and in Tables 10-11 and Figures 7-11 for the social impacts.	Deliverable D3.1. and D3.3.: main results of the qualitative analysis, focusing on the severe impacts of t-shirt.
3. Identify and validate hotspots	The joint results using science-based technical data and stakeholder judgements are provided in Tables 17 and 18.	

Finally, results using science-based technical data (WP5) and stakeholder judgements (WP3) are jointly analysed, in order to identify and validate the environmental and social hotspots of a cotton-made t-shirt (Tables 17 and 18).

Environmental hotspots analysis associated with a cotton-made t-shirt lifecycle

Table 17 shows the environmental hotspots analysis associated with a cotton-made t-shirt lifecycle. There is a set of impact categories that has been identified as hotspots for both sources of information (technical results and stakeholder judgements). These are:

- (i) Impact category 'Human toxicity – cancer effects' in 'fabric production' lifecycle phase, related to 'Chemical pollution/Water pollution' identified by the qualitative analysis.
- (ii) Impact category 'Ecotoxicity – fresh water' in 'raw material acquisition' lifecycle phase, related to 'Chemical pollution/Water pollution' identified by the qualitative analysis.
- (iii) Impact category 'Human toxicity – non-cancer effects' in 'fabric production' lifecycle phase, related to 'Chemical pollution/Water pollution' identified by the qualitative analysis.

Table 17. Environmental hotspots analysis from quantitative and qualitative analysis of a cotton-made t-shirt

		Lifecycle Phases				
Impact Category		Raw material acquisition	Fabric production	Garment Manufacturing	Consumer Use	End of the life
1	Water resource depletion					
2	Human toxicity - cancer effects	Chemical pollution/ Water pollution	Chemical pollution/ Water pollution	Chemical pollution/ Water pollution		
3	Ecotoxicity – fresh water	Chemical pollution/ Water pollution	Chemical pollution/ Water pollution	Chemical pollution/ Water pollution		
4	Human toxicity – non- cancer effects	Chemical pollution/ Water pollution	Chemical pollution/ Water pollution	Chemical pollution/ Water pollution		
5	Ozone depletion	Chemical pollution/ Water pollution	Chemical pollution/ Water pollution	Chemical pollution/ Water pollution		
6	Ionizing radiation –					

	human health effects					
7	Particulate matter/ respiratory inorganics	Chemical pollution/ Water pollution	Chemical pollution/ Water pollution	Chemical pollution/ Water pollution		
8	Climate change					
9	Acidification	Chemical pollution/ Water pollution	Chemical pollution/ Water pollution	Chemical pollution/ Water pollution		
10	Mineral fossil and resource depletion					
11	Terrestrial eutrophication	Chemical pollution/ Water pollution	Chemical pollution/ Water pollution	Chemical pollution/ Water pollution		
12	Photochemical ozone formation	Chemical pollution/ Water pollution	Chemical pollution/ Water pollution	Chemical pollution/ Water pollution		
13	Freshwater eutrophication		Chemical pollution/ Water pollution	Chemical pollution/ Water pollution		
14	Land Use					



Hotspots identified in both quantitative and qualitative analysis

Hotspots partially identified only from qualitative analysis

Hotspots identified only from quantitative analysis

Non-identified as hotspots

Source: Own creation based on Table 9 and the results included in SMART Deliverable D3.1

Social hotspots analysis associated with a cotton-made t-shirt lifecycle

In social terms, Table 18 presents the social hotspots analysis associated with the cotton-made t-shirt lifecycle. There is a set of impact categories that has been identified as hotspots for both sources of information (technical results and stakeholder judgements). These are:

- (i) Social category 'Human rights'. Impact category 'Gender equity' in 'fabric production' lifecycle phase, which can be connected to the risk 'Gender related discrimination and violence' in the qualitative analysis.

Table 18. Social hotspots analysis from quantitative and qualitative analysis of a cotton made T-shirt

Social Category	Impact Category	Lifecycle Phases				
		Raw material acquisition	Fabric production	Garment Manufacturing	Consumer Use	End of the life
Labor rights and decent work	Collective Bargaining					
	Wage Assessment					
	Migrant Labor					
	Poverty					
	Forced Labor					
	Child Labor					
	Social Benefits					
	Excessive Working Time					
Health and safety	Toxics and Hazards					
	Injuries and Fatalities					
Human rights	High Conflict					
	Gender Equity	Gender related discrimination and violence	Gender related discrimination and violence	Gender related discrimination and violence		
	Indigenous Rights					
Governance	Corruption					
	Legal System					
Community infrastructure	Hospital Beds					
	Improved Sanitation					
	Drinking Water					



Hotspots identified in both quantitative and qualitative analysis

Hotspots partially identified only from qualitative analysis

Hotspots identified only from quantitative analysis

Non-identified as hotspots

Source: Own creation based on Table 11 and the results included in SMART Deliverable D3.1

Another remarkable result is that in both quantitative and qualitative analyses, there is not any hotspot in the 'Consumer Use' and 'End of life' phases in textile case study.

3.5.2.2. Hotspots analysis in a mobile phone Company

Table 19 shows the three key methodological steps in Hotspots Analysis connected with key actions for their application in a mobile phone Company. The goal is to identify the lifecycle stage which accounts for a significant proportion of the environmental and social impact of the mobile phone in those previously identified as priority aspects. As it was above mentioned, we will integrate two parallel works based on a mobile phone: i) WP5 technical and science-based footprints impact categories study, and ii) WP4 sustainability hotspots analysis.

Regarding the definition of goal and scope and for case study purposes, WP5 designed three scenarios presented in section 2 of this deliverable. Each of these scenarios was defined considering its own boundaries and hypotheses of the mobile phone case study, varying the percentages of the mobile phone's residue allocated to landfill in the 'End-of-Life' phase (75%, 30% and 5%), disassembly (20%, 60% and 20%) and reuse (5%, 10% and 75%). The application of the Organization Sustainability Framework Analysis (Step 1 of the SAF) and the use of Environmental and Social footprint tools (Step 2 phase 1 of the SAF), provides a science-based battery of potential environmental and social impacts, whose scope is homogeneously defined by the Organisational Environmental Footprint from the European Commission and the UNEP/SETAC methodology respectively. In addition, in a SMART project context, this phase adds expert knowledge from WP4, which explored the hotspots analysis in the lifecycle of two mobile phones based on a literature review, interviews and discussions with stakeholders.

Table 19: Step 2 Phase 2 application. Hotspots Analysis Tool in Mobile phone Company case study

Issues considered	Application following the Sustainability Assessment Framework	Connection with WP4 process and results
1. Define goal and scope	Three scenarios defined for case study purposes. Analysis carried out based on technical and science-based methodologies defined in Step 2 phase 1 of the SAF (environmental and social footprints impact categories).	Deliverable D4.1: hotspots analysis in the lifecycle of two mobile phones (a composite mobile phone and the Fairphone 2) based on a literature review, interviews and discussions with stakeholders.
2. Gather data, seek expert advice	Science-based results of the quantitative data included in Tables 12-13 and Figure 12 for the environmental impacts and in Tables 14-15 and Figures 13-17 for the social impacts.	Deliverable D4.1. and D4.3: main results of the qualitative analysis, focusing on the severe impacts of composite mobile phone.
3. Identify and validate hotspots	The joint results using science-based technical data and stakeholder judgements are provided in Tables 20 and 21.	

Next step concerns the gathering of data and seek of expert advice. In this sense, the SAF defined by WP5 uses the science-based results of the quantitative analysis obtained after the application of the abovementioned environmental and social footprint methodologies over the different mobile phone end-of-life scenarios. These results

regards both the most relevant social and environmental impact categories and the lifecycle stages which account for a significant proportion of those priority aspects (see section 3.5.1.2. for detailed results). As in the previous step of this SAF hotspots analysis tool, and in a SMART project context, the main results obtained from the qualitative analysis carried out focusing on the severe impacts of composite mobile phone provided by WP4 in deliverable D4.1. and D4.3., are also integrated.

Finally, results using science-based technical data (WP5) and stakeholder judgements (WP4) are jointly analysed, in order to identify and validate the environmental and social hotspots of a mobile phone (Tables 20 and 21).

Environmental hotspots analysis associated with a mobile phone lifecycle

Table 20 displays the environmental hotspots analysis associated with a mobile phone lifecycle. There is a set of impact categories that has been identified as hotspots for both sources of information (technical results and stakeholder judgements). These are:

- (i) Impact category 'Mineral fossil and resource depletion' in 'resource extraction and production' lifecycle phases that can be connected to the risk 'Biodiversity loss (Hazardous materials/ecotoxicity)' in the qualitative analysis.
- (ii) Impact category 'Human toxicity – cancer effects' in 'resource extraction and production' lifecycle phases that can be connected to the risk 'Biodiversity loss (Hazardous materials/ecotoxicity)' in the qualitative analysis.

Table 20. Environmental hotspots analysis from quantitative and qualitative analysis of a mobile phone

Impact Category		Lifecycle Phases			
		Resource extraction	Production	Consumer Use	End of the life
1	Mineral fossil and resource depletion	Biodiversity loss (Hazardous materials/ Ecotoxicity)	Biodiversity loss (Hazardous materials/ Ecotoxicity)		Hazardous materials/ Ecotoxicity
2	Human toxicity- cancer effects	Biodiversity loss (Hazardous materials/ Ecotoxicity)	Biodiversity loss (Hazardous materials/ Ecotoxicity)		Hazardous materials/ Ecotoxicity
3	Particulate matter/ respiratory inorganics				
4	Freshwater eutrophication				
5	Acidification				
6	Human toxicity – non-cancer effects	Biodiversity loss (Hazardous materials/ Ecotoxicity)	Biodiversity loss (Hazardous materials/ Ecotoxicity)		Hazardous materials/ Ecotoxicity
7	Climate change				
8	Photochemical ozone formation				
9	Ecotoxicity – fresh water	Biodiversity loss (Hazardous materials/ Ecotoxicity)	Biodiversity loss (Hazardous materials/ Ecotoxicity)		Hazardous materials/ Ecotoxicity
10	Terrestrial eutrophication				
11	Ionizing radiation – human health effects	Biodiversity loss (Hazardous materials/ Ecotoxicity)			
12	Land Use	Biodiversity loss (Hazardous materials/ Ecotoxicity)			
13	Ozone depletion				
14	Water resource depletion				



- Hotspots identified in both quantitative and qualitative analysis
- Hotspots partially identified only from qualitative analysis
- Hotspots identified only from quantitative analysis
- Non-identified as hotspots

Source: Own creation based on Table 13 and the results included in SMART Deliverable D4.1

Environmental hotspots analysis associated with a mobile phone lifecycle

Table 21 presents the social hotspots analysis associated with the mobile phone lifecycle. There is a set of impact categories that has been identified as hotspots for both sources of information (technical results and stakeholder judgements). These are:

- (i) Social category 'Labor rights and decent work'. Impact category 'Collective bargaining' in 'production' lifecycle phase, that can be connected to the risk 'Labor Rights (No union work)' in the qualitative analysis.
- (ii) Social category 'Labor rights and decent work'. Impact category 'Wage assessment' in 'production' lifecycle phase, that can be connected to the risk 'Labor Rights (low wages)' in the qualitative analysis.
- (iii) Social category 'Health and safety'. Impact category 'Toxics and hazards' in 'resource extraction' and 'production' lifecycle phases, that can be connected to the risks 'Eco-human toxicity' and 'Labor Rights (Hazardous materials/Human toxicity)' in the qualitative analysis.

Another remarkable result is that in both quantitative and qualitative analyses, there is not any hotspot in the 'in the 'Consumer Use' in the mobile phone case study.

Table 21. Social hotspots analysis from quantitative and qualitative analysis of a mobile phone

Social Category	Impact Category	Lifecycle Phases			
		Resource extraction	Production	Consumer Use	End of the life
Labor rights and decent work	Collective Bargaining		Labor Rights (No union work)		
	Wage Assessment		Labor Rights (Low wages)		
	Migrant Labor				
	Poverty				
	Forced Labor				
	Child Labor				
	Social Benefits		Labor Rights (Precarious work)		
	Excessive Working Time		Labor Rights (Excessive overtime)		
Health and safety	Toxics and Hazards	Eco-human toxicity	Labor Rights (Hazardous materials/Human toxicity)		Hazardous materials/ Human toxicity
	Injuries and Fatalities				
Human rights	High Conflict				
	Gender Equity				
	Indigenous Rights				
Governance	Corruption				
	Legal System				
Community infrastructure	Improved Sanitation				
	Hospital Beds				
	Drinking Water				

	Hotspots identified in both quantitative and qualitative analysis
	Hotspots partially identified only from qualitative analysis
	Hotspots identified only from quantitative analysis
	Non-identified as hotspots

Source: Own creation based on Table 15 and the results included in SMART Deliverable D4.1

3.5.2.3. Hotspots Analysis Tool. Concluding remarks

This section describes the application of the three key methodological steps that comprise the Hotspots Analysis in both simulated case studies, a textile product and a mobile phone.

Note that the SAF establishes that the technical results derived from Phase 2, Step 1 ‘footprints tools’ should be provided to experts and stakeholders for discussion and subsequent validation. However, in the context of SMART project and with the aim of using as expert knowledge the results of WP3 and WP4, the expert advice required in Step 2 ‘Hotspots Analysis Tool’ has proceeded on the basis of the parallel work developed by WP3 and WP4 in order to analyze hotspots. Both works have not been developed with a single methodology, this means that each of the analysis has been done using different impact categories/risks connected with each sector. This implies an important limitation when matching the impact categories that comes from SAF with WP3 and WP4 outputs. Nonetheless, in order to carry out this phase, we propose to associate the WP3 and WP4 sustainability hotspots with WP5 technical and science-based footprints impact categories.

Results show there is a set of impact categories with, in a first stage, a lack of consensus between the results derived from the quantitative analysis and the qualitative analysis. But, given that in this case, both analyses have been done in parallel, the definitive selection of hotspots would require an additional analysis to decide whether or not some of these impacts should also be considered hotspots.

Despite the limitations and the need of additional analysis abovementioned, it is relevant to highlight the flexibility of the SAF tool to integrate other qualitative and externally produced knowledge in its inherent decision-making process. This flexibility not only enriches of the tool application, but also replicates what is usual in organizations’ management environment, that is, the use and integration of diverse informational sources.

Connected to the continuous improvement process that underlies the whole Sustainability Assessment Framework, both case studies should identify and prioritize

actions to eliminate or reduce the impact of hotspots and propose process indicators and best practices in order to manage them (see section 3.3. for more details).

3.5.3 Phase 3: Evaluation Tool - Sustainability Footprint

The results obtained in phases 1 and 2 of the SAT are considered to evaluate sustainability performance. This evaluation is based on multi-criteria decision-making methodologies (fully developed in SMART Deliverable 5.5 Multi-criteria Decision Framework to Assess Supply Chain Management), since it allows us to overcome the current sustainability assessment limitations. The outcomes of this phase allow for the detection of deficiencies that cause certain scores and to establish concrete objectives for the improvement of sustainable management through the use of corrective measures.

The sustainability footprint should be elaborated considering the following key questions:

- (i) **Sustainability Assessment Tool Inputs:** these inputs would be obtained from previous phases of the Tool, i.e. phase 1 'Footprint' (Environmental, Social and Economic footprints) and phase 2 'Hotspots' (Hotspots management). Given that the normalization, ponderation and aggregation of impact categories are still in progress, both in the European OEF and in the UNEP/SETAC S-LCA methodology, and given the lack of suitable databases to measure the economic footprint (SoGReS-MF), it is not possible to have a global environmental, social and economic indicator as input for the Sustainability Footprint.
- (ii) **Method:** Fuzzy Multi-Criteria Decision-Making Method- Fuzzy Inference System (Mamdani type). The above-mentioned limitations regarding the availability of synthetic indicators do not allow us to apply these methodologies as they are established in the deliverable D5.5. 'Multi-criteria Decision Framework to Assess Supply Chain Management'.

However, the deliverable D5.5. ‘Multi-criteria Decision Framework to Assess Supply Chain Management’ provides a transitional solution to obtaining a Sustainability Footprint defined in the following linguistic categories Extremely Strong (ES), Very Strong (VS), Strong (S), Fairly Strong (FS), Medium (M), Fairly Weak (W), Weak (W), Very Weak (VW) or Extremely Weak (EW). For that aim, it is up to a group of experts to determine the significance of the results presented by the different impact categories in the three footprints in order to categorize them as Strong (S), Medium (M) or Weak (W) footprint. The stronger the footprint, the worse for sustainability. This information is not available in the textile and mobile phone cases, therefore, in the application of SAF, step 3 in phase 2 ‘Sustainability assessment tool’ has not been carried out.

3.6. Step 3: Reporting Tool

Organizations measure and communicate to internal and external stakeholders their environmental, social and management performance, and then set goals to manage change more effectively. Transparency about non-financial performance can help reduce reputational risks, open up dialogue with stakeholders, and demonstrate leadership, openness and accountability.

The minimum relevant information on sustainability content, which the companies report to their internal and external stakeholders, should cover the outputs from the different Sustainability Assessment Framework Steps and Processes:

From Sustainability Assessment Framework Step 1, companies communicate the board commitment to sustainability, the governance managerial bases, objectives and scope of the report, show the position of the company within its supply chains, the process followed to identify the key issues for the company and stakeholders and the description of the business strategy with objectives and tracking metrics.

From Sustainability Assessment Framework Step 2, companies provide intelligible information about their impacts, presenting the footprints and the hotspots analysis results in an aggregate manner, highlighting the most impacting categories, and hyperlinking them with full footprints and hotspots technical reports.

Following the Sustainability Assessment Framework Step 2, companies should provide a sustainability score based on social, economic and environmental footprints and on hotspots management initiatives. However, current technical limitations do not allow to obtain this score in such a way as it integrates the full scope defined in SAF.

Based on the assurance process, the report will include the verification by a third party on non-financial information presented.

The report should comply with the principles of comparability, relevance, impact, robustness, completeness, accessibility and truthfulness.

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