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Carbon handprint – Communicating the good we do

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<p>Summary</p> <p>The concept of handprint has been introduced to measure and communicate the positive changes of actions and the beneficial impacts created within the life cycle of products, services, processes, companies, organizations or individuals. A handprint of a product can be created either by preventing or avoiding negative impacts (footprints), or by creating positive benefits. The handprint of a company considers the footprint of the company itself, but also the positive changes the company influences to impacts of individuals or other companies.</p> <p>Handprinting addresses the same comprehensive set of sustainability impacts to environmental aspects as footprinting, e.g. climate change and resource depletion. Both handprinting and footprinting utilize the same LCA-based approaches and frameworks and consider the full value chain. Carbon handprint refers to benefits related to climate change, i.e. carbon handprint studies are limited to consider only the impacts on global warming potential. The calculation of a handprint can be done by comparing the beneficial actions against the business as usual.</p> <p>By using carbon handprints, companies can take a proactive role and demonstrate leadership in addressing climate change challenges, reduction of GHG emissions and promotion of carbon neutral or low-carbon products, solutions and services. Handprints can support the product or process design/redesign; informed decision-making and strategic management; sustainability assessment and associated performance measurement; reporting; marketing; certification/labelling; and creating product declarations. However, common and widely accepted calculation guidelines for handprints are still missing. Thus, the carbon handprint concept and associated assessment approaches need to be developed further to be easily applicable and useful.</p>		
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Foreword

Businesses and industry play a crucial role in the global transition towards a carbon-neutral circular economy. They have the capacity to innovate and to create the necessary products and solutions while improving their own competitiveness. However, in doing so, companies will always leave a measurable carbon footprint.

But instead of just concentrating on the negative effects of a carbon footprint we should pay attention to a more positive message that can raise awareness about climate change and its associated perils. A new concept – the carbon handprint – can highlight the more positive environmental impacts of companies' endeavours. While the carbon footprint is the sum of the negative impacts one's actions have on the environment, the carbon handprint measures the positive efforts made to reduce one's own or another's carbon footprint. And the goal is, of course, to make your handprint larger than your footprint.

For a company, a carbon handprint helps broaden the scope of corporate sustainability. By focusing on this handprint, companies can also show leadership, improve their own performance and competitiveness, become more sustainable, and contribute to society in many ways. The handprint concept allows the Finnish cleantech sector to promote the benefits of the global battle against climate change in a more understandable and measurable way.

Sitra wants to help Finnish industry by providing facts, methods and models to be used in the transformation to carbon neutrality. For this purpose it is necessary to understand the handprint concept, describe the methodology and explain why and how companies should measure and use their own carbon handprint to showcase the benefits at a corporate level.

This research report is the result of work carried out by the sustainability assessment team of VTT Technical Research Centre of Finland Ltd, and the preliminary overview is a jointly funded project with the Finnish Innovation Fund Sitra and VTT. It aims to analyse the handprint concept and associated approaches from a corporate perspective with special emphasis on the carbon handprint concept and related research and development needs.

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1. Introduction

Sustainability reporting is relevant to all companies in all industrial sectors. Many indicators and meters of sustainability show that the Finnish companies are operating efficiently and that the environmental aspects are considered at the production, management and strategy level. The environmental impacts of actions are in many cases measured continuously and reported on a yearly basis at minimum. However, the benefits of cleantech operations and the high environmental knowhow of companies are not easy to communicate.

The need for measuring positive actions has been answered with the handprint concept, which is described in this report. The goal of this preliminary overview was to study the status of handprints in Finland and globally. It also describes handprint methodology development by different actors and gives practical examples of handprint calculations. The report was written based on information found from public sources; mainly articles, reports, and homepages of companies/organizations. Thus this preliminary overview is public and available for anyone interested in handprints.

This report presents the concept of handprint by introducing the background, terminology and definitions related to it in chapter 2. Chapter 3 describes the methodology related to handprint calculations by firstly explaining the similarities and differences of handprints and footprints, and secondly describing some guidelines related to greenhouse gas (GHG) calculations. Benefits of handprints for companies, and the challenges and future needs related to them are also presented in chapter 3. Chapter 4 shows some international and Finnish examples of calculating and reporting of environmental benefits, even though they are not all using the term “handprints”. Finally, chapter 5 includes a summary and conclusions of the preliminary overview of handprints.

2. Handprint concept

This chapter introduces the background, terminology and definitions related to handprints.

2.1 Background

The 4th International Conference on Environment Education (2007) launched the handprint concept. It was launched as a measure of Education for Sustainable Development action aiming at decreasing the human footprint and making the world more sustainable. Specifically, handprint was created to be a symbol of, measure for and commitment to positive action towards sustainability (Handprint 2015). The handprint concept can be applied for products, processes, companies, organizations or individuals with certain adjustments, and it can consider the impacts on environment or society (Norris 2015a).

The concept of handprint has been introduced to measure and communicate the positive changes of actions and the beneficial impacts, whereas the footprint measures the negative impacts in terms of emissions and resource consumption (Norris 2015a, Biemer et al. 2013a). Operating an organization always creates some kind of footprint, but it can also bring positive changes and benefits to the surrounding world. The estimate of those positive impacts is called a handprint (Norris 2015b).

The positive impacts of processes, products, companies or organizations have been described by several actors in some form. The World Business Council for Sustainable Development (WBCSD) and the International Council of Chemical Associations (ICCA) have presented guidelines for calculation of avoided emissions in chemical industry (ICCA and WBCSD, 2013). The guideline doesn't use the term “handprint” but represents the same idea: assessing the greenhouse gas emissions avoidance potential of chemical products during their life cycle. The guideline can thus be applied for handprinting as well. Additionally,

the handprint concept has been discussed by e.g. Gregory A. Norris (2011, 2013, 2015a,b), Jon Biemer et al. (2013a,b), and Katriina Alhola et al. (2015).

Handprint is based on basic principles: the delivered benefit and the good we do. Handprint builds on the concept of ecological footprint and the handprint concept is characterized by unlimited potential and self-reinforcing positive feedback loop (Biemer et al. 2013a,b). Although handprint complements the ecological footprint, these two are different concepts. The main difference in viewpoints or ideas of handprint and footprint according to Biemer et al. (2013a,b) are summarised in Table 1. As a concept, handprint thinking goes beyond footprint thinking, and handprints can be created in addition to minimizing footprints.

The metrics of environmental handprints include the metrics of accomplishment and small steps (e.g. technology innovations, pilot projects, demonstrations, experiments or even failed programmes with many good lessons to be learned) contributing to a major outcome. Thus, handprint is very much about presenting individual outcomes which together form a bigger picture. In addition to own efforts, handprint is also about influencing others through engagement of creativity, innovation, entrepreneurship, profit and idealism (Biemer et al. 2013a,b).

Table 1. The ideas of handprint and footprint according to Biemer et al. (2013 a, b)

Handprint thinking	Footprint thinking
The good we do	The harm we do
Unlimited potential	Limited resources
Recover/Restore	Reduce/Reuse/Recycle
Influence/Educate/Inspire	Admonish
Count accomplishments	Measure quantities
Appreciate/Celebrate	Calculate
Advocate protection	Resist destruction
Entrepreneurism	Problem solving

2.2 Definitions of handprint

Handprinting is a rather new concept, and a generally accepted or standardized definition for it is still missing. However, a few examples can be found from the literature.

According to Norris (2015a), a **handprint of a product** can be created either by preventing or avoiding negative impacts (footprints) that would otherwise have occurred, or by creating positive benefits that would not have occurred. Thus environmental handprint considers per se the entire life cycle or supply chain of a product or an entity. It essentially describes the reduction of environmental footprint through e.g. choice of alternative technology, being more energy efficient, recycling, re-use, reduction of resource use and overall consumption.

The **handprint of a company** considers the footprint of the company itself, but also the positive changes the company brings out/causes to impacts of individuals or other companies (Norris 2013, ICCA and WBCSD, 2013). This includes the changes in the supply chain and also takes into account the changes which are *indirectly* associated with the goods and services the company produces. Handprints can take place anywhere in the world and they can be composed of multiple small impact reductions.

Norris (2011) introduced the term “**beneficient**” combining efficient (minimization of footprint) and beneficial (generation of positive impacts). Organizations can operate beneficently

through making their handprints bigger than the footprints of their products or services. In addition, companies can produce beneficent products, which means that consumers buying those products add nothing to their personal footprints. Norris points out that when studying handprints or beneficency, each impact category can be addressed separately even though many changes will bring co-benefits on many other categories. Thus e.g. benefits to climate change aspect can be described as carbon handprint.

The concept of being **NetPositive** (introduced by Norris 2015) means “doing more good than harm” (Norris, 2015a), i.e. the handprint of a company is bigger than the footprint during the same time period. Every organization and product has a footprint (e.g. carbon footprint), and it needs to be continuously measured and reduced. If an organization aims at becoming Netpositive, it also needs to create positive change with associated impacts and benefits and by doing that measure and grow its handprints at the same time (Norris 2015a).

One key scoping question relating to NetPositive accounting of an entity (e.g. an organization) is whether the reductions in its own footprint are credited in its handprint. Norris (2013, 2015a) concludes that there are two perspectives (see Table 2) depending on whether the existence of some organization is considered to be a legitimate part of business as usual.

Table 2. Handprint definitions adapted from Norris (2011)

Perspective	Organizational handprinting
Standard perspective	Changes to own footprint relative to own business as usual (i.e. supplying the demand of this year similarly to last year's demand) + changes to footprints of others relative to their business as usual
Contingent existence perspective	The benefits of your existence (impacts of own production – the impacts of average production) + changes to footprints of others relative to their business as usual

From the “doing more good than harm” perspective that he calls the “**standard perspective**”, the existence of an organization is taken as given and an organization is part of both change and business as usual scenarios. This means that reductions to negative impacts the organisation causes are a benefit for all (whether they occur within the scope of the footprint of that organization or not) and the company gets handprint credit for own footprint reductions.

From the “making the world better off with you than without you” perspective that Norris calls “**contingent existence perspective**”, one scenario has the organization absent from the earth and the other has it present polluting and making reductions in the footprints of others at the same time. From this perspective the organization does not have a footprint if it does not exist at all, and reductions in its own footprint are not counted as a part of organization’s handprint. Linking this perspective to final market demand implies a more complex and data intensive approach. For example, if a company produces more energy-efficient products than average it means that its absence from the market (one scenario) leads to increased energy consumption (and to larger footprint). Therefore, company handprinting from the “Contingent existence perspective” includes estimation of the difference between own footprint and the average footprint of producing the same quantity of output by someone else. This means that data on the footprint of average production of similar goods and services in the market is needed (Norris 2013).

According to Norris (2015a), it seems reasonable to allow both perspectives as possibilities at this point in the development of Handprint-based Netpositive Assessment and make sure

that NetPositive Assessment communications clearly and transparently describe which of the two perspectives was adopted. However, the baseline definition will require a lot of assumptions especially in the contingent existence perspective, and thus there might be significant uncertainties that must be considered when making the actual calculations.

According to Norris (2011), handprinting is open to accounting for any and all kinds of causal influence and it focuses on assessing the impacts of efforts we make at changing the world. Simple methods such as “Linked Event Modelling” can be applied to building and documenting models of cause and effect between events and identification of handprint partners whose efforts made it possible to have the handprint. Linked event modelling makes it possible to construct and publish simple models to provide a graphical presentation of the chains of dependence/consequence for an event, co-causers of an event, impacts of an event and other relevant results. It also supports calculation of results (consequence/dependence chains and impacts of events) including the total impacts of an event and its consequences as well as listing/reporting the co-causers of a given set of impacts (Norris 2011).

Handprinting encourages actors to be a cause of positive change anywhere and everywhere in the world. It also enables them to reach their impact outside the life cycles of the produced and consumed goods and services, which causes a broader set of impact-generating influences called “**ripple effects**” (Norris 2015a). Positive ripple effects can be a driver for more positive ripple effects globally, for example, through engagement of customers to co-create handprints by more efficient use of products.

However, typically, we manage what we measure and therefore management for and achievement of NetPositive status requires measurement of “the good we do” (handprints) in ways that are consistent with the measurement of “the harm we cause” (footprints). Thus, handprints have to be footprint-consistent estimates of positive change. Therefore in actual handprint calculations ripple effects are often left out.

Handprint as well as NetPositive status can be also determined based on an impact category. If your handprint is larger than your footprint for a given impact category it means that you are NetPositive for that impact category (Norris 2015a).

Development of **collective handprints** is possible through energy and environmental design (Biemer et al. 2013a,b). Collective handprints mean major accomplishments that have been influenced by several actors within a long period of time. Biemer et al. mention development of wind power technologies and solar cookers as examples of collective handprints.

3. Handprint methodology

This chapter describes the methodology related to handprint calculations by firstly explaining the similarities and differences of handprints and footprints in chapter 3.1. Secondly, since the handprints are closely related to footprints, the chapter 3.2 describes some guidelines related to greenhouse gas calculations. Benefits of handprints for companies, and the challenges and future needs related to them are also presented in chapters 3.3 and 3.4, respectively.

3.1 Background – Handprint vs. Footprint methodology

Handprinting has similarities with footprinting since it addresses the same comprehensive set of sustainability impacts to environmental aspects, e.g. climate change and resource depletion as well as social aspects, e.g. human rights and working conditions. Both handprinting and footprinting utilize the same LCA-based approaches and frameworks and consider the full value chain (Norris 2013). The methods, data, tools and results of life cycle

assessment form a good start for both handprinting and footprinting. In addition, both can be calculated on product, company, service, process, solution or supply/value chain level. Both consequential (change-oriented and focused on the consequences of possible future changes between alternative product systems) and attributional (impacts of specific product system based on an account of the history of the product) LCA can be applied in these assessments (Norris 2013).

However, handprinting is also different from footprinting mainly because it focuses on changes to the future, including accounting for changes which occur outside of the scope of the footprint of some specific handprinter (Norris 2013). Therefore, the scope of handprinting for companies includes, apart from changes to their footprint, also causal pathways changing the upstream and downstream direct requirements of their own goods and services. In handprint concept, the assessment of the impact of a change typically involves comparison with business as usual situations: what would have happened without the attempted change.

According to Norris (2011), many actors can be considered responsible for the same impact in footprinting and handprinting. This implies that events can have multiple causes and they can cause other events, i.e. causal chains. Typically footprint is used to assess the impact of a single product, operation or company, but it can also be applied to a set of actors (for example product manufacturer and a customer) with focus on the union of their activities.

Handprints complement the footprint. Handprints use similar quantitative and life cycle based assessment methods but address a much wider scope of action with global focus and take into account multiple impact categories for companies to strive towards being NetPositive. Handprint concept covers also a growing set of sustainability dimensions such as climate change, human health, biodiversity, water consumption as well as a growing set of social performance indicators. With better handprint assessment tools companies are encouraged to create handprints to benefit people (e.g. well-being of the workforce, well-being of communities and families) and cause positive impacts and effects in this field, as has been the case with environmental benefits and impacts (SHINE Summit 2015).

3.2 Current methodologies for GHG calculations

This chapter firstly describes the current guidelines suggested for (carbon) handprinting. Secondly, calculation guidelines for avoided GHG emissions in the chemical industry are presented. Finally, since the carbon handprint is closely related to carbon footprint calculations, the GHG protocol and the technical specification of carbon footprint are described.

3.2.1 Handprint calculation according to SHINE and G. Norris

Sustainability and Health Initiative for NetPositive Enterprise (SHINE) is a program at the Harvard T.H. Chan School of Public Health. SHINE was launched by the Center for Health and the Global Environment in 2013 to engage businesses on the challenges of sustainability and health for both people and the planet. SHINE has been developing the concept of Handprint with Dr. Gregory Norris. Measuring of handprints is carried out in accordance with international LCA standards, tools and reporting frameworks which address also the multiple dimensions of footprints (SHINE Summit 2015).

In handprinting, the scope includes changes which companies influence in the consumption and impacts of individuals, in addition to those directly linked with the goods and services they produce. Additionally, the changes in the consumption and impacts of other organizations (e.g. companies in the supply chain and organizations in local communities) can be included into the scope of company handprinting. Handprint can be about global

impacts with focus on the footprints of other actors and it can be composed of many small reductions in impacts (Norris 2013).

Handprinting includes three steps (SHINE Summit 2015):

- **Measure and reduce company footprint**, e.g. reduce emissions, promote eco-efficiency in supply chains and dematerialize goods and services.
- **Support others to reduce their footprints**, e.g. promote innovations in supply chain which reduce the footprints of goods and services sold to other companies, improve use phase efficiency, educate downstream customers to use products more effectively or efficiently, share innovations with other businesses, and grow demand for own products with better performance, i.e. smaller footprint than displaced products.
- **Take generative actions** which address the same kind of impact categories for which footprints are causing negative impacts.

Handprint-Based NetPositive Assessment (HBNA) takes into account the full life cycles of products. It covers all parts of a life cycle affected by change or decision and all impacts caused by an actor/entity. The way, and in what context, a product is used determines whether the use of that product creates benefits that exceed the costs of achieving those benefits. The two ways to create a handprint are (Norris 2015a):

- **Create positive benefits** which would not otherwise have occurred (create positive benefits relative to business as usual).
- **Prevent/avoid footprints** that would otherwise have occurred including reduction of the magnitude of footprints that occur relative to what their magnitude would otherwise have been (reduce total footprints relative to business as usual).

Product-related handprints can be created in the following ways (Norris 2015a):

- **Improvement of the life cycle performance of an existing product** through innovation (future demand is met by an improved solution)
- **Introduction of a new product with better performance** than other products in the markets (displaces their demand)
- **Increase of the demand for an existing product** (replacing the demand for other products on the market with lower performance)

Norris (2015a) suggests equations for product-related NetPositive Assessment i.e. Handprint calculations. The basic equation for calculating product-related handprints is (Norris 2015a):

$$\text{Handprint} = F_b - F_n$$

where

F_b is the Business-as-usual Footprint of the product over its lifecycle, and

F_n is the New Footprint of the product over its life cycle

The footprint of a product is calculated as cradle-to-grave (or cradle-to-end-of-life) and can be calculated for a specific impact category (e.g. carbon or climate change). A handprint based on footprints referring to the benefits related to reduction of GHG emissions is called a carbon handprint.

Norris (2015a) takes the definition of handprint and the calculation equations further by introducing also the effects of functional demand and market demand, affordability, and

different kinds of changes in market shares. The equations in this case can be rather complex, and the determination of which equation to use can be difficult. Thus the actual calculation might not be very easy to do with the guidelines of Norris.

The scope of the footprint assessment in HBNA focuses on cradle-to-gate portion of product lifecycles (Norris 2015a). In HBNA, the footprint of an entity (i.e. a company) is defined as the sum total of the negative impacts caused by all the processes needed to sustain and enable that organization to operate and perform its mission. Using life cycle assessment (LCA) terminology, footprint refers to the “cradle-to-gate footprint” for the entity, and using GHG Protocol (presented in chapter 3.2.3) terminology, it refers to the Scope 1 (direct GHG emissions) + Scope 2 (electricity indirect GHG emissions) + Scope 3 upstream footprint (other indirect GHG emissions).

According to Norris (2015a), this does not cause incompleteness problems because the scope of handprint covers also direct and indirect influences across the scope of the full life cycle. The handprint of an entity is therefore (Norris 2015a):

- The footprint-consistent impacts of changes caused by the entity relative to that what would have happened without the entity being an agent of change.
- The net change brought about by that entity (positive/beneficial or not) measured in the same impact units as used in footprinting.

In other words, the HBNA framework defines that handprints are the impacts of those changes that an entity causes in the world while operating, whereas footprints are the impacts caused by enabling the entity to live or operate. The scope of the handprint system and handprinting encompass (Norris 2015a):

- Direct and indirect influences across the scope of the total life cycle.
- Causal pathways which generate the changes in direct and indirect impacts.
- Other equally impactful ways that companies and production can create influence on the world.

3.2.2 Avoided emissions guidelines for chemical industry WBCSD and ICCA

The guidelines of World Business Council of Sustainable Development (WBCSD) and International Council of Chemical Associations (ICCA) for chemical industry were published in 2013 (ICCA and WBCSD 2013) to support chemical companies in assessing the GHG emissions avoidance potential of their products. The avoidance potential can be called as carbon handprint, even though the guidelines do not use that term. Since chemicals are used in multiple industrial sectors, they play a major role in controlling the climate change. The chemical industry can have an impact on GHG reductions by reducing its own emissions from the manufacturing facilities and supply chains, but also by developing such products that reduce emissions when used by other industries and consumers.

There can be two objectives of studies based on these guidelines (ICCA and WBCSD 2013). Firstly, the calculations allow the chemical companies to “quantify the extent to which a chemical product creates fewer emissions compared to an alternative chemical product”. Secondly, companies can “assess the contribution of chemical products to emissions avoided by the use of a specific low-carbon technology that makes use of chemical products, compared with the technology or mix of technologies currently used or implemented”.

The guidelines are based on LCA and ISO standards and are consistent to GHG Protocol Product Life Cycle Accounting and Reporting Standard (2011), BSI PAS2050 (2011) and Carbon footprint of products standard (ISO/TS 14067:2013). They consider the full life cycle of products, or at least identical parts or processes of the comparable life cycles. They require detailed descriptions of assumptions about the future conditions and suggest

qualitative scenario analysis for alternative future developments. The credibility of communication is ensured by reporting the main results of the company's solution and of the comparative solution, *presenting the avoided emissions as difference of emission profiles* divided into life cycle phases, and stating that the credit for avoided emissions belongs to the complete value chain.

The guidelines set criteria to the baseline against which the avoided emissions are calculated. The criteria states that the compared solutions must:

- be at the same level in the value chain,
- deliver the same function to the user,
- be used in the same application,
- be distributed/used on the market,
- be exchangeable for the typical customer in the selected market in terms of quality criteria, and
- be as consistent as possible with the solution of the reporting company in terms of data quality, methodology, assumptions etc.

The guidelines also include reporting requirements concerning functional unit, calculation methodologies and attribution of avoided emissions to value chain partners. The last-mentioned topic is crucial and has to be considered carefully in order to avoid double-counting. The document does not provide detailed guidelines on quantitative attribution of avoided emissions, but suggests a process to that in which all value chain partners are involved. (ICCA and WBCSD 2013).

3.2.3 The GHG Protocol

Since the carbon handprint concept is closely related to carbon footprint calculations, the GHG Protocol (2015) as a guideline for carbon footprint calculations is presented in this chapter.

The Greenhouse Gas (GHG) Protocol is a partnership with multiple stakeholders (e.g. business, governments and non-governmental organizations). The World Resources Institute (WRI) and World Business Council for Sustainable Development (WBCSD) play a key role in this approach and associated development work. The GHG Protocol develops internationally accepted GHG accounting and reporting standards and tools. These standards support organizations on how to measure, manage and report greenhouse gas emissions. As a whole, the GHG Protocol is the most widely used international accounting tool for government and business leaders to understand, quantify and manage GHG emissions.

The GHG accounting and reporting are based on the principles of relevance, completeness, consistency, transparency and accuracy (GHG Protocol 2015). In brief, *A Corporate Accounting and Reporting Standard* (WBCSD;WRI 2004), *Corporate Value Chain (Scope 3) Accounting and Reporting Standard* (WBCSD;WRI 2011a) and *Product Life Cycle Accounting and Reporting Standard* (WBCSD;WRI 2011b) as a whole provide a comprehensive approach to value chain GHG measurement and management which serve multiple business goals of reporting companies. The scope of these standards from the product-based perspective is presented in Figure 1.

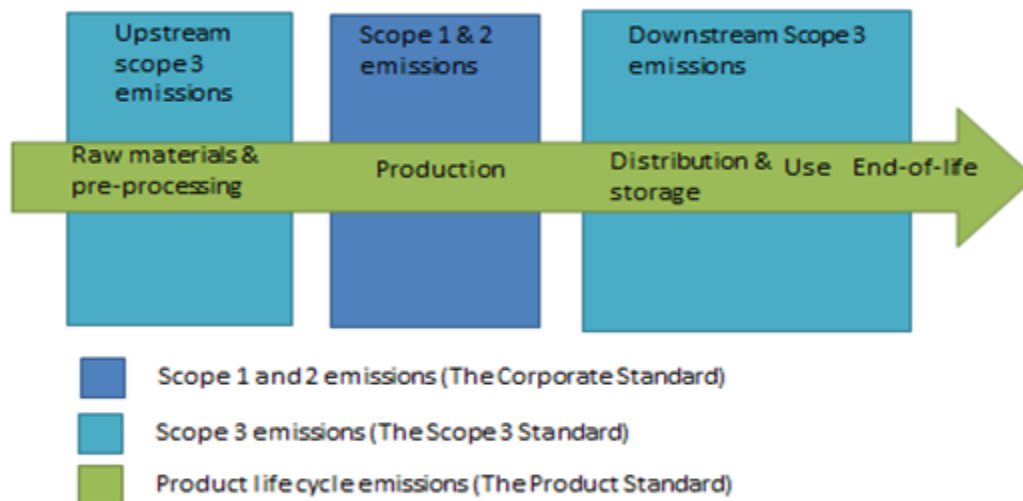


Figure 1. Product-based presentation of the scopes of the Corporate, Scope 3 and Product Standards. Adapted from the Product Life Cycle Accounting and Reporting Standard (WBCSD;WRI 2011b).

The Corporate Accounting and Reporting Standard (WBCSD;WRI 2004) provides instructions for companies on how to carry out GHG inventories encompassing scopes 1 (Direct GHG emissions) and 2 (Electricity indirect GHG emissions). Direct GHG emissions come from sources that are owned or controlled by the company. Indirect GHG emissions are a consequence of the activities of the company but these emissions come from sources owned or controlled by another company.

A public GHG emissions report, which is in accordance with the GHG Protocol Corporate Standard, includes the following information:

- 1) description of the company and inventory boundary,
- 2) information on emissions,
- 3) optional information on emissions and performance (e.g. scope 3) and
- 4) information on off sets (purchased or developed outside the inventory boundary subdivided by GHG storage/removals and emissions reduction).

To avoid double counting companies should identify/exclude any scope 2 or 3 emissions from their reports that are also reported as scope 1 emissions by other companies, unit or facilities.

The Corporate Value Chain (Scope 3) Accounting and Reporting Standard (WBCSD; WRI 2011a) provides instructions for companies on how to carry out scope 3 GHG inventories covering emissions from their whole value chains. This standard complements, builds on, and should be used together with the Corporate Standard. However, it does not cover avoided emissions or GHG reductions from compensation or off setting actions.

According to the standard (WBCSD; WRI 2011a), companies can meet their GHG reduction targets through internal reduction at sources within the target boundary, or through additional use of offsets from GHG reduction projects that reduce emissions or enhance sinks at external sources. These offsets must be based on credible accounting. GHG reduction opportunities may also exist beyond the scope 1, 2 and 3 inventories of a company, e.g. avoided emissions in society resulting from use of products and solutions of that company compared to alternatives or avoided emissions from recycling. If these avoided emissions are to be estimated, a project accounting method is required, using e.g. accounts for GHG reductions by quantifying impacts from individual GHG mitigation projects relative to a

baseline. Avoided emissions must also be reported separately from company's scope 1, scope 2 and scope 3 emissions.

Product Life Cycle Accounting and Reporting Standard (WBCSD; WRI 2011b) addresses the full life cycle emissions of a product. It can be used to promote better understanding of these emissions and to guide action towards addressing the biggest GHG reduction opportunities. It provides guidance and basic requirements for companies on how to quantify and report product specific GHG emissions inventories and removals. The purpose of this standard is to promote more sustainable products. It can also help companies to use information generated in product design to increase efficiency, reduce costs and remove risks as well as to communicate environmental information to customers.

This standard provides a framework for companies to address GHG emissions reductions associated with products (goods or services) they are designing, manufacturing, selling, using or purchasing. The limitation of a product GHG inventory is that it does not take into account potential environmental impact trade-offs or co-benefits. Thus the results of these inventories should not be used to communicate the overall environmental performance of a product.

3.2.4 Carbon footprint of products

Since the carbon handprint concept is closely related to carbon footprint calculations, the guidelines for carbon footprint calculations are presented in this chapter.

Carbon footprint of products (CFP) (ISO/TS 14067:2013) standard provides principles, requirements and guidelines for the quantification and communication of the carbon footprint of products, including both goods and services. Partial product footprints are also addressed. The calculation is based on life cycle assessment using the single impact category of climate change. In this technical specification the carbon footprint quantification and reporting of a product is based on the principles of the LCA (ISO 14040:2006; 14044:2006). Also a guideline for quantification and reporting of greenhouse gas emissions for organization exists (ISO/TR 14069:2013).

Life cycle assessment using climate change as the single impact category creates a method for carbon footprint assessment, facilitates performance tracking in GHG emissions reduction and supports reporting and communication of carbon footprint information (BSI PAS 2050). Double-counting of emissions and removal should be avoided within both the studied product system and other product systems (in the context of allocation).

Public communication of carbon footprints can support a company to provide information to consumers and other interested parties as well as show company's commitment to address climate change challenges. The carbon footprint communication options identified in this standard are external communication report, performance tracking report, CFP label and CFP declaration (ISO/TS 14067:2013).

Carbon footprint calculates the contribution of the analysed product to global warming potential. The most important greenhouse gases are fossil carbon dioxide (CO₂), methane (CH₄) and dinitrogenmonoxide (N₂O). The greenhouse gases are converted into carbon dioxide equivalents (CO₂ eq.) by multiplying them with factors given by Intergovernmental Panel on Climate Change (IPCC 2007). The factors describe the global warming potential of emissions within the next 100 years. The CO₂ equivalents are then summed together and reported as carbon footprint. The factors for the most important greenhouse gases are reported in Table 3.

Table 3. Conversion factors of the most important greenhouse gases to carbon dioxide equivalents by IPCC (2007)

	Conversion factor by IPCC
Carbon dioxide, CO ₂	1
Methane, CH ₄	25
Dinitrogenmonoxide, N ₂ O	298

Fossil-based greenhouse gas emissions are rather straight-forward in carbon footprint calculations, but carbon sequestration in forests and end products as well as biogenic CO₂ emissions have to be considered carefully. The ISO technical specification demands to report biogenic emissions separately (ISO/TS 14067:2013), because biogenic carbon is more time-dependent than the fossil emissions. Fossil emissions can be considered to be released “today”, while the biogenic carbon in a book, a chair or a house can be sequestered in the product for years, decades or even centuries.

Carbon neutrality is a term that has been widely used in the public, although the content of it varies a lot. It can be understood as zero fossil greenhouse gas emissions to atmosphere, or that the amount of released emissions is compensated by investing in projects that are mitigating GHG emissions elsewhere (Alhola et al. 2015). Both perspectives have deficiencies, since the dynamics of biogenic carbon and land use change are very complex in the first approach, and the compensation doesn’t remove the released emissions and their impacts from the atmosphere in the second approach. Thus the background and assumptions of carbon neutrality should always be reported in high level of detail.

Compensating for all or a part of the CFP in a process outside the boundary of the product system through prevention, reduction or removal of GHG emissions is called “Offsetting”. It is, however, not allowed to use offsetting in product specific carbon footprint calculations (ISO/TS 14067 2013).

3.3 Benefits of handprints for companies

Generating handprints is about actions that increase sustainability and well-being, and reduce harmful activities and impacts in terms of both people and the planet (SHINE Summit 2015). The idea is to create positive changes in the whole supply chain from raw material acquisition to factories and to customers. Handprinting also highlights the positive approach to impact assessment that can motivate and inspire company staffs and promote creativity and new ideas on how to create more positive company impacts. There are multiple potential application fields for handprint and new ones are bound to arise as the development work proceeds in various sectors.

For a company, handprinting helps to broaden the scope of corporate sustainability and promotes a systemic thinking model which takes into account the positive actions and impacts of company operations. By using handprints, companies can take a proactive role and demonstrate leadership in addressing climate change challenges, reduction of GHG emissions and promotion of carbon neutral or low-carbon products, solutions and services. They can use handprints for voluntary innovation aiming at continuous improvement of their performance in this field and for demonstrating positive impacts of their actions. In addition, this approach contributes positively to informed decision-making, overall sustainability management covering the whole value chain and to management of change.

The handprint approach provides an opportunity to work towards having a larger handprint globally and being an agent of positive change and part of a group of actors that create positive impacts. Moreover, it can be used to promote the active role of companies in

inspiring and motivating positive changes and impacts locally, nationally and globally including their contribution to international sustainable development goals.

The handprint approach allows active role in delivering positive value and impacts in addition to traditional focus on minimization of risks and negative impacts and reporting on footprints of products or companies. Handprinting can also support company activities in the fields of corporate climate action and science-based emissions reduction targets in many ways.

Significantly enhanced focus on GHG aspects including carbon handprints and footprints can support company and business unit level development to become more sustainable and use resources and energy more efficiently, be a driver for high level innovations and contribute to multiple positive links with society, customers, investors and employees. Achievement of potential benefits requires management level commitment and leadership. Handprint approach has to be integrated to overall sustainability management and reporting practices in companies, including measures to produce high quality materials, databases and measurement approaches. Market potential is of course a major driver to carbon handprint, jointly within enabling policy and regulatory frameworks.

Handprint can also lead to better profitability in long term. Delmas et al. (2015) studied the relationship between environmental and financial performance in the context of GHG emissions. Their findings suggest that the improvement of corporate environmental performance causes a decline in short-term financial performance indicator. However, they noted that investors consider that there is potential long-term value in improved environmental performance. They also note that the relationship between environmental and financial performance depends on the time horizon of the financial performance evaluation. They conclude that investing in proactive environmental strategies is profitable in the long term even though it might be costly in the short term.

Similarly to life cycle assessment and footprints, handprints can be used in multiple ways, such as in product development and improvement, strategic management and planning, marketing, reporting and policy development. In life cycle assessment, the focus is typically on a product system which covers the full life cycle of the studied product, including various unit processes and flows with multiple inputs and outputs. This kind of systematic life cycle thinking is very relevant in the handprinting approach as well. Use of handprint concept may result in sharpening of company's systemic change processes. Company guidance on handprint assessment and reporting is bound to include linkages to existing standards, frameworks, concepts and assessment approaches, e.g. various GHG reduction and carbon footprint initiatives and tools.

Handprinting approach provides an interesting way to address both negative and positive environmental impacts associated with operations, innovations, products, services, solutions and applications of various companies in many sectors. Having measures for improvement and positive contributions towards sustainability are especially important for forerunner companies, who need means for communicating about the positive impacts of their actions and potential innovations. Measuring positive contribution towards sustainability would be useful also for SME's and start up's focusing their business around environmental innovations and cleantech solutions.

3.4 Challenges and future needs of handprints

For modern companies, it is important to be active in sustainability management, assessment and reporting. Thus the handprint concept and approach can be very beneficial to promote international competitiveness and to create good society and stakeholder relations globally and locally.

A transparent and robust method for measuring and communicating carbon handprints and overall sustainability performance could be a useful tool for creating competitive advantage

for the forerunner companies and at best promoting further activities with positive impacts to wellbeing of both people and the environment along the value chain. Wider use of handprint concept also requires global benchmarking, consideration of compatibility with existing tools and methods, as well as definition of terminology. These would all save resources of companies interested in applying the new method in practice.

Furthermore, companies could benefit a lot from the development of the sustainability handprint concept as a science-based assessment method for measuring and communicating positive contributions, actions and impacts. This kind of comprehensive approach contributes to better understanding of both company and value/supply chain performance and their key elements. A common argument is that companies cannot manage what they do not measure. In this case this phrase could be supplemented by the fact that measuring requires understanding and awareness of the concept and approach. Therefore, it is essential that better methodologies for measuring and calculating handprints are developed.

However, handprints and handprinting are a relatively new field of research and development work and thus there still are also major challenges in this field.

One challenge in handprint calculations can be the definition of the baseline, i.e. situation against which the comparison of achieved benefits is made. Norris (2013) states that individual and organizational handprinting rely on projections of both individual and organizational business as usual footprints. However, he notes that complete forecasts of business as usual and business of the future are not necessarily needed, since it is often possible to simplify the modeling by focusing only on the differences between the business as usual and the actual projections.

Norris (2013) suggests a *flat baseline assumption for personal handprints*, meaning that without conscious efforts the yearly footprint of an individual will remain the same as last years. He states that the *baseline for organization* is more complex, though. One option he suggests is that the business as usual (BAU) for this year for a company is one in which the company serves this year's demand with last year's product models, produced using last year's production methods (Norris 2013). Another option is to build the baseline on forecasts of market demand and market shares of new product versus old products (2015a), but again this can be a bit challenging.

Focus is also needed on shared responsibility of impacts. Credit or responsibility of handprints may overlap in customer chains, so one has to be careful not to do double-counting of the impacts of the same event. This means that a set of actors may have overlaps in their handprints including the same events or improvements, and thus their total handprint can be less than the sum of their individual handprints (Norris 2013). The same applies to footprints, and needs to be considered carefully when making also footprint calculations.

The carbon handprint concept and associated assessment approaches need to be specified further to be easily applicable and useful. The definition and the conceptual framework of handprint need to be developed further including guidance for carbon handprint assessment. From the company perspective, this calls for attention to and guidance for many theoretical and practical issues such as the following examples:

- Definition of terminology, goal and scope.
- Baseline definition and selection.
- Full life cycle considerations.
- Avoidance of too complicated and costly options (simple solutions).
- Benchmarking options and levels.
- Transparency and accountability.
- Definition of performance levels.

- Product LCA and market, industry and technology average (baseline considerations).
- Use of public and private databases and sources of information.
- Comparison of products.

In brief, there is a need to address methodological development for handprinting through science-based approach in a comprehensive and consistent way, and to build it on a holistic understanding of the overall framework and its key elements. Based on these, guidance can be developed including goal, scope and baseline considerations in accordance with life cycle thinking. Specific company cases based on realistic conditions could be very beneficial for the demonstration and testing of the handprint concept and associated assessment approaches. At the moment, only a few examples of handprint related studies can be found internationally, and there is a need to develop common calculation principles and guidelines which are based on scientific methods and principles. Companies need simple approaches with clear terminology, scopes and baselines taking into account market drivers.

4. International and Finnish business examples

This chapter shows some international and Finnish examples of calculating and reporting of environmental benefits, even though they are not all using the term “handprints”.

4.1 Handprints of product innovation – an example case study

Norris and Phansey (2015) presented a case study on handprints of product innovations with focus on computer-aided design in the automotive sector, in this case vehicle lightweighting and aerodynamics in particular. Focus was on the improvement of life cycle performance of an existing product through innovation, based on the idea that future demand for the product in question is met by the new improved solution instead of the pre-innovation solution. Handprint of an entity was defined as the footprint-consistent impacts of changes caused by that entity, in relation to the case in which that entity would not have been an agent of change. This created net change was measured in the same impact units as used in footprinting.

A scoping LCA was applied in the study, including a simple description of a product or a set of alternatives or scenarios. This description was used to construct a quantitative model of the product or alternatives, linking to the final model also secondary data (Ecoinvent database) of the supply chain impacts of every input.

The life cycle was divided into four phases: 1) upstream (cradle-to-final production), 2) final production, 3) use and 4) end-of-life management. Regarding each life cycle phase, only that part of the life cycle that was changed by the innovation was modelled. The information needs for the estimation of the handprint of the innovation were the following:

- An estimate of the material and energy inputs to the manufacturing phase which are affected by the innovation,
- An estimate how the use phase is affected by the innovation, e.g. changes to fuel economy, maintenance and durability,
- An indication whether or not end-of-life management, e.g. recycling, would be affected by the innovation,
- Estimated mileage during the lifetime of the vehicle,
- A value for the relevant Innovation Relevant Time Horizon (product dependent duration of time over which sales of some innovated product contribute to the total handprint of some particular innovation) and
- Forecasts of annual sales.

The results for each impact category (e.g. global warming) included the impacts that occurred in the year of production with upstream impacts, including impacts of changes to materials, energy needed to manufacture the vehicle and full supply chain impacts of the altered inputs to vehicle manufacturing. The impacts that occur and accumulate across the vehicle life cycle (i.e. impacts caused by innovation-driven changes to the use phase such as improvements in vehicle fuel economy), were also included in the results.

The upstream handprint was assessed based on the difference between the pre-innovation upstream footprint and the post-innovation upstream footprint:

$$\text{Handprint}_u = Fb_u - Fn_u,$$

where

Fb_u is the Business-as-usual or pre-innovation upstream Footprint, and

Fn_u is the New or post-innovation upstream Footprint.

The handprint of the innovation had dynamic character, because it was created based on the difference between pre-innovation and post-innovation impacts. The developed innovation approaches to counting life cycle handprints included e.g. the impact-year method (counting impacts during each year in which they occur) and the sales year method (counting during the year of installation).

In footprinting, there can be shared responsibility (attributed to multiple actors for some given impact) and similarly in handprinting there can be shared credit (multiple actors can take credit for their jointly caused handprinting action). This case and associated Handprint-Based NetPositive assessment approach indicated that product-related innovations can create handprints, which can be measured in the same units as and are directly comparable with footprints. In this connection, a large handprinting potential for computer-aided innovation in terms of GHG emissions and also in other impact categories was found (Norris and Phansey 2015).

4.2 Ecofys and avoided emissions

Ecofys consulting company is working e.g. in the fields of sustainable energy, climate policy and carbon efficiency. They have reviewed avoided emissions case studies, addressed calculation method aspects and calculated avoided emissions for products as well as developed a tool for calculating GHG emission reductions for ICT products (Ecofys 2016a,b). Their work on avoided emissions (in accordance with ICCA and WBCSD 2011 definition) is quite similar to handprint development of SHINE (2015). The rationale for this work is to go beyond emission reductions in the operations, facilities and supply chains of companies through product design that reduces emissions downstream in the value chains (for example customers). Thus, innovative products and their markets are essential in this context.

Company activities to reduce emissions focus on their own facilities and value chains (scope 1, 2 and 3 in accordance with GHG Protocol approach). Further reductions can be achieved by so called green product portfolios (avoided emissions), e.g. by using innovative and less polluting new product in the value chain of some other product to create emission reductions. Avoided emissions (The GHG Protocol 2015) refer to emission reductions that are a result of the use of that product, but take place outside of a product's life cycle or value chain (Ecofys 2016a; 2014). Thus, avoided emissions refer to the difference of emissions between two alternative solutions (ICCA and WBCSD 2013).

According to Ecofys (2016a;2014) one key challenge for companies is how to communicate/report emission reductions in a credible and comparable way. This can be addressed through practical guidelines, which increase consistency in both assessment and

reporting practices in the field of avoided emissions. Communicating avoided emission can benefit the company in marketing purposes, customer relations, differentiation from competitors and awareness raising in the value chain and among stakeholders.

The potential for companies is large and there are multiple opportunities for various products and also sectors to use avoided emissions (Ecofys 2016a; 2014). Krabbe et al. (2015) recognized the importance of corporate climate action as a driver towards a low-carbon economy and they noted that there is a lack of clear methods for corporate target setting in accordance with specific carbon budget based on globally agreed goals. In addition, they proposed one approach (the Sectoral Decarbonization Approach) to setting corporate emissions target which derives carbon intensity pathways for companies based on sectoral pathways from existing mitigation scenarios. Those targets would take initial performance specifications and activity growth into account and the applied key inputs would comprise, for example, company and sectoral production and emissions levels and market shares (Krabbe et al. 2015).

Ecofys participated in ICCA and WBCSD (2013) work on guidelines on accounting and reporting greenhouse gas emissions avoided along the value chain of chemical products. The guidelines based on the work of a large task force with the idea to provide one global standard methodology on how to calculate and communicate GHG benefits of company projects. These guidelines (presented earlier in chapter 3.2.2) can be used as a benchmark for other sectors as well.

4.3 The SKF BeyondZero portfolio

The SKF (Svenska Kullagerfabriken AB) BeyondZero portfolio was created from a customer perspective and it encompasses SKF products and solutions, which generate significant environmental benefits for its customers (SKF 2016a,b,c). SKF also recognises that the most significant contribution to climate change mitigation can be made in the use phase (SKF 2016c).

The solutions in the portfolio must provide significant benefits without major environmental trade-offs from a life cycle perspective and address one or more defined environmental challenges such as climate change, use of natural resources and the avoidance of environmental contamination. SKF (2016c) recognizes the opportunities and responsibilities associated with global environmental sustainability challenges, such as climate change. It also notices the competitive advantage aspects based on increasing energy prices due to resource limitations and carbon pricing.

In SKF's portfolio, the basic approach (SKF 2016a,c) is that a product or solution for any industry or segment can be designed for environment and provide direct environmental benefits through its characteristics. Alternatively, it can be applied for environment to support the improvement of the environmental performance of some system (customer application) or to enable growth of environmentally sound sectors (e.g. renewable energy and materials recycling). The benefits are assessed through comparison of the environmental performance of SKF solutions with a defined baseline (SKF 2016a). The products and solutions in the portfolio are used to measure, communicate and drive the environmental value delivered to customers and there are yearly third party audits. The goals of the protocol comprise (SKF 2016b):

- Reduction of the negative environmental impact from both own operations and those of suppliers.
- Innovation and offering of new technologies, products and services with improved environmental performance features for customers.

The portfolio addresses different environmental aspects such as energy efficiency, material selection, reduction of lubricant leakage, and re-using, reducing and recycling of materials. Comparison to defined baseline means that the compared SKF products, technologies and services meet specific performance criteria established and demonstrated by using credible methods such as life cycle assessment (SKF 2016b). SKF has developed its own methodology using and applying various emerging methodologies and standards, because there are not yet established industry-wide standards for calculating environmental benefits of products and services during the customer use phase.

The main features of the methodology for calculating GHG emissions savings encompass the following (SKF 2016a,c):

- Focus on GHG emissions (CO₂ equivalent emissions) because climate change is one of the most pressing environmental impacts globally and it is very relevant to the business of SKF.
- Goal is to provide a simple and credible approach to quantify the company contribution to GHG emissions savings at the customers through company solutions. Both goal and scope definition are supported by the ISO 14044 standard.
- The functional unit describes the function of the application of the customer (all environmental impacts relate to this unit) taking into account the magnitude of the function, the duration of the function, the service life of that function and the expected level of quality.
- System boundary (as narrow definition of system as possible) includes raw material production, manufacturing, transport, use and disposal phases of the solution. The use phase assessment includes GHG emissions associated with customer and potentially also of the customer of the customer.
- In GHG emission savings calculations SKF solutions are compared to the baseline solution, which are defined as the most common alternative solution on the market (the most likely alternative to the SKF solution providing an equivalent function including solutions of other companies or previous SKF products).

Data collection is carried out as an iterative process using both primary and secondary sources. It starts from the most significant life cycle phase in terms of improvement potential and moves then to other life cycle phases of the studied solution (SKF 2016a). For the baseline solution zero impacts are assumed for any other life cycle phases than the use phase. Detailed data on the studied SKF solution is collected only for those life cycle phases that together account for more than 10% of the total improvement. The phases that contribute to less than 10% of the total are addressed using generic data from databases. Guidance on allocation from ISO 14044 is adapted to the purposes of the methodology and a common format is used for documentation of calculations (SKF 2016a,c).

4.4 The Outotec Sustainability Report 2014

The sustainability report of the Outotec company in 2014 is about maximizing handprint. It presents the positive impacts of company solutions and services, for example, in the fields of resource efficiency and reduction of environmental footprint. The report presents examples of actions taken towards maximization of handprint. It addresses issues such as

- positive effects associated with avoided emissions
- positive handprint in the sustainable use of natural resources
- creation of sustainability impacts (handprints) in and reduction of the ecological footprint of the operations of customers
- expanding of handprint through development of innovative technologies, applications and solutions.

The report focuses on communicating positive impacts of company's solutions and innovative products and services taking into account emissions reductions compared to some defined baseline level (Outotec 2015).

It was noted in the report that the largest impact (handprint) was created downstream in the operations of customers. According to the report, Outotec is making a significant positive handprint in the sustainable use of natural resources through provision of innovation technologies, solutions and applications to its global customers. This work includes focus on the positive impacts and making the most of transformative potential including helping of customers to reduce the ecological footprints of their operations, improvement of resource efficiency, enhancement of the recovery of valuable materials, energy and water use efficiency and emissions reduction. In Outotec's case interlinked value chains with associated impacts and considered life cycles encompass development of products and services for customers, delivered customer solutions, use of products (and recycling) and services by customers as well as materials equipment and services provided by suppliers (Outotec 2015).

The focus areas of handprint maximization in Outotec (2015) covers own technologies and achievements reached through working together with customers. Handprint approach also indicates to customers that environmental considerations are taken into account from the early stages of product and service development. The long-term target of Outotec also involves the handprint approach, since avoided emissions through the use of company's technologies compared to industry average and reduction of harmful impacts have been taken into account in measuring the company performance. Typical benefits of innovative product or process related solutions include smaller energy consumption and associated lower emissions. For example, metallurgical industry can avoid emissions by using technologies such as ferrochrome process and copper flash smelting. Outotec creates a bigger positive impact (in terms of avoided emissions) than GHG emissions from its own operations and its supply chain.

Outotec has assessed the carbon footprint of some of its technologies and carried out a life cycle assessment screening study focusing on the environmental impacts of some of its products. The report also states that the footprint of customers can be assessed based on their raw materials and process parameters. It also recognizes the importance of a sustainable supply chain including analysis of the associated carbon footprint in terms of GHG emissions (Outotec 2015).

4.5 Company perspectives on carbon neutrality / Syke

Companies can contribute to the transition towards a carbon-neutral society and this line of work requires rethinking of many things (Alhola et al. 2015). The role of innovations, products and solutions that promote more sustainable practices is significant in this process. Carbon neutrality is widely used in communication by multiple actors, but its definition is not a simple task and there are many interpretations. Nowadays, the term is often considered to mean a long term strategic vision or a target for future activities. In addition, it is often considered to indicate zero net GHG emissions to the atmosphere.

According to some sources, carbon neutrality could be achieved through a three step process involving calculation, reductions and compensation/offsetting of GHG emissions (Alhola et al. 2015). For example, the BSI PAS 2060 Carbon Neutrality (2016) standard includes requirements for achieving and demonstrating carbon neutrality encompassing guidance on the measurement of carbon footprint (in accordance with ISO 14064 or GHG Corporate Protocol), carbon management plan for emission reductions, offsetting of emissions (carbon credits), disclosure of documentation covering emission reductions and offsets and final verification process.

The vision/future target perspective of carbon neutrality highlights long term strategic vision and in addition to emissions reductions it is also about a business goals and includes commitment to sustainability, innovative solutions, more efficient products and continuous improvement of operations. Thus it is different from the perspective focusing only on short term process involving those three steps mentioned earlier.

Carbon neutrality offers many benefits to companies such as increased demand for carbon-free products, active role in the development of new products, new business opportunities, reduction of energy use, better cost efficiency and better competence on and understanding of own operations and those of supply chains. In addition, companies can support customers to decrease their carbon footprints through energy efficient and innovative solutions and they can measure and communicate this effectiveness as a positive handprint. Handprinting approach is not widely used yet, but is raising interest among Finnish companies (Alhola et al. 2015).

4.6 Gesi SMARTer 2020

The Global e-Sustainable Initiative (GeSI) is an international strategic partnership of over 30 ICT (information and communications technology) companies and industry associations. GeSI and its members are committed to creating and promoting technologies and practices that foster economic, environmental and social sustainability and drive economic growth and productivity. Formed in 2001, GeSI fosters global and open cooperation, informs the public of its members' voluntary actions to improve their sustainability performance and promotes technologies that foster sustainable development.

In 2012, GeSI published a report called GeSI SMARTer 2020. It demonstrates how the increased use of information and communication technology (ICT), such as video conferencing and smart building management, could cut the projected 2020 global greenhouse gas (GHG) emissions by 16.5%. This would amount to \$1.9 trillion in gross energy and fuel savings and a reduction of 9.1 gigatonnes carbon dioxide equivalent (Gt CO₂ eq.) of greenhouse gases. This is equivalent to more than seven times the ICT sector's emissions in the same period. The emission reductions would take place in several sectors, e.g. in power sector, transportation, agriculture and land use, buildings, manufacturing, and consumer and service. (GeSI 2012) Also in #SMARTer2030 –report in 2015 the same approach was continued, quantifying also the far-reaching social and economic benefits of ICT (GeSI 2015). This kind of approach can be seen as handprinting, even though the term is not used in the report.

5. Summary and conclusions

It is important for modern companies to focus on leadership and proactive approach to sustainability management. The handprint concept and approach provide a good framework and tool for the creation, management, measurement and reporting of positive changes and impacts. This new approach contributes to multiple benefits in the field of environmental performance development. Handprints can support the product or process design/redesign; informed decision-making and strategic management; sustainability assessment and associated performance measurement; reporting; marketing; certification/labelling; and creating product declarations.

Companies can benefit from the handprint approach in many ways. Handprints can help companies e.g. to:

- **broaden the scope of corporate sustainability** by taking into account the positive actions and impacts of company operations during the full life cycle of their products

- **communicate and demonstrate leadership** in addressing climate change challenges, reduction of GHG emissions and promotion of carbon neutral or low-carbon products, solutions and services
- **improve their performance** continuously by creating voluntary innovation
- **become more sustainable** and use resources and energy more efficiently within the entire value chains
- **contribute in multiple positive ways** to society, customers, investors and employees
- **achieve better profitability** in long term, and
- **improve several actions**, e.g. product development, strategic management and planning, marketing, reporting and influence in policy development.

Life cycle and systemic thinking are at the core of the handprint framework and there are direct links to the footprint concept. Handprint and footprint with their associated assessment methodologies are both based on life cycle thinking and life cycle assessment (LCA) and handprinting can apply many aspects of footprinting assessments. Both approaches address the full life cycles of products and services. Footprint refers to the sum of negative impacts caused within the life cycle of a product or service, whereas the handprint focuses on beneficial and positive environmental and social impacts that can be achieved through intentional future changes. Carbon handprint means handprinting with focus on one impact category (climate change) and in LCA the chosen impact category would typically be Global Warming Potential (GWP) using CO₂ equivalent as unit of measurement.

Handprint is mostly about positive impacts, and for companies this means that active development and improvement measures such as new innovation, products, solutions or services are essential for developing and growing the handprint.

Multiple authors have defined the handprint concept and it refers to positive action and to beneficial environmental and social impacts. Moreover, it is about making active changes to the future and assessment of the impacts of those positive changes. In a way, handprint is about creating change towards sustainability through complementing the footprint approach and reducing footprint through active development and improvement measures. In brief, handprint is about voluntary and intentional positive actions and changes towards sustainability with emphasis on continuous improvement of environmental performance including measurement of both positive and reduced negative impacts.

Both handprint and footprint approaches need to consider a broad set of actors and their activities within a complex global operational environment and international market, including a network of multiple value/supply chain actors. This implies that careful considerations are needed in assessment procedures by all involved parties to maintain a comprehensive, consistent and logical approach and to avoid double-counting. Common and widely accepted calculation guidelines for handprints should thus be developed.

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