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1. Definitions/vocabulary

allocation

Partitioning the input or output flows of a process or a product system between the product system under study and one or more other product systems

[BS EN ISO 14044:2006, 3.17].

anticipated life cycle greenhouse gas emissions

Initial estimate of greenhouse gas that is calculated using secondary data or a combination of primary and secondary data, for all processes used in the life cycle of the product.

business-to-business

Provision of inputs, including products, to another party that is not the end user.

business-to-consumer

Provision of inputs, including products, to the end user.

capital goods

Goods, such as machinery, equipment and buildings, used in the life cycle of products

carbon dioxide equivalent (CO2e)

Unit for comparing the radiative forcing of a GHG to carbon dioxide

[BS ISO 14064-1:2006, 2.19]

Note 1 *The carbon dioxide equivalent value is calculated by multiplying the mass of a given GHG by its global warming potential (see 3.25 for a definition of global warming potential).*
Note 2 Greenhouse gases, other than CO2, are converted to their carbon dioxide equivalent value on the basis of their per unit radiative forcing using 100-year global warming potentials defined by the Intergovernmental Panel on Climate Change (IPCC).

carbon footprint

The total amount of greenhouse gases produced to directly and indirectly support human activities, usually expressed in equivalent tons of carbon dioxide (CO2).

combined heat and power (CHP)

Simultaneous generation in one process of useable thermal, electrical and/or mechanical energy.

consumable

Ancillary input that is necessary for a process to occur but that does not form a tangible part of the product or co-products arising from the process

Note 1 *Consumables include lubricating oil, tools and other rapidly wearing inputs to a process. Consumables differ from capital goods in that they have an expected life of one year or less, or a need to replenish on a one year or less basis.*

Note 2 *Fuel and energy inputs to the life cycle of a product are not considered consumables.*

consumer

User of goods or services.

co-product

Any of two or more products from the same unit process or product system

[BS EN ISO14044:2006, 3.10]

Note Where two or more products can be produced from a unit process, they are considered co-products only where one cannot be produced without the other being produced.

data quality

Characteristics of data that relate to their ability to satisfy stated requirements

[BS EN ISO14044:2006, 3.19].

downstream emissions

GHG emissions associated with processes that occur in the life cycle of a product subsequent to the processes owned or operated by the organization.

emission factor

Amount of greenhouse gases emitted, expressed as carbon dioxide equivalent and relative to a unit of activity Note For example, kgCO2e per unit input. Emission factor data would be obtained from secondary data sources.

emissions	Release to air and discharges to water and land that result in GHGs entering the atmosphere.
environmentally extended input–output (EEIO) analysis	Method of estimating the GHG emissions (and other environmental impacts) arising from sectors within an economy through the analysis of economic flows. *Note Alternative terms, such as economic input-output life cycle assessment (EIO-LCA), input output based life cycle assessment (IOLCA) and hybrid life cycle assessment (HLCA) refer to different approaches to implementing EEIO analysis.*
functional unit	Quantified performance of a product system for use as a reference unit [BS EN ISO 14044:2006, 3.20].
GHG emissions	Release of GHGs to the atmosphere.
global warming potential (GWP)	Factor describing the radiative forcing impact of one mass-based unit of a given greenhouse gas relative to an equivalent unit of carbon dioxide over a given period of time [BS ISO 14064-1:2006, 2.18]. *Note Carbon dioxide is assigned a GWP of 1, while the GWP of other gases is expressed relative to the GWP of carbon dioxide from fossil carbon sources. Annex A contains global warming potentials for a 100-year time period produced by the Intergovernmental Panel on Climate Change. Carbon dioxide arising from biogenic sources of carbon is assigned a GWP of zero in specific circumstances specified in this PAS.*
greenhouse gases (GHGs)	Gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of infrared radiation emitted by the Earth's surface, the atmosphere, and clouds *Note The GHGs included in this PAS are specified in Annex A.*
input	Product, material or energy flow that enters a unit process [BS EN ISO 14040:2006, 3.21].
life cycle	Consecutive and interlinked stages of a product system, from raw material acquisition or generation of natural resources to end of life, inclusive of any recycling or recovery activity [Adapted from BS EN ISO 14040:2006].
life cycle assessment (LCA)	Compilation and evaluation of inputs, outputs and potential environmental impacts of a product system throughout its life cycle [BS EN ISO 14040:2006].
life cycle GHG emissions	Sum of greenhouse gas emissions resulting from all stages of the life cycle of a product and within the specified system boundaries of the product Note *This includes all emissions that are released as part of the processes within the boundary of the life cycle of the product, including obtaining, creating, modifying, transporting, storing, operating, using and end of life disposal of the product.*
marketplace	A peer-to-peer network, where a peer is an environmental data source, offering shared information or service through unified interfaces for the network participants.
output	Product, material or energy that leaves a unit process [Adapted from BS EN ISO 14044:2006]. Note *Materials may include raw materials, intermediate products, co-products, products and emissions.*
primary activity data	Quantitative measurement of activity from a product's life cycle that, when multiplied by an emission factor, determines the GHG emissions arising from a process.

	Note 1 *Examples of primary activity data include the amount of energy used, material produced, service provided or area of land affected.* Note 2 *Primary activity data sources are typically preferable to secondary data sources as the data will reflect the specific nature/efficiency of the process, and the GHG emissions associated with the process.* Note 3 *Primary activity data does not include emission factors.*
product	Any good or service. Note *Services have tangible and intangible elements. The provision of a service can involve, for example, the following:* *a) an activity performed on a consumer-supplied tangible product (e.g. automobile to be repaired);* *b) an activity performed on a consumer-supplied intangible product (e.g. the income statement needed to prepare a tax return);* *c) the delivery of an intangible product (e.g. the delivery of information in the context of knowledge transmission);* *d) the creation of ambience for the consumer (e.g. in hotels and restaurants);¨* *e) software consists of information and is generally intangible and can be in the form of approaches, transactions or procedures.* [Adapted from BS ISO 14040:2006]
product category	Group of products that can fulfil equivalent functions [BS ISO 14025:2006].
product category rules (PCRs)	Set of specific rules, requirements and guidelines for developing Type III environmental declarations for one or more product categories [BS ISO 14025:2006, 3.5].
product system	Collection of unit processes with elementary and product flows, performing one or more defined functions, that models the life cycle of a product [BS EN ISO 14040:2006].
raw material	Primary or secondary material that is used to produce a product Note *Secondary material includes recycled material.* [BS EN ISO 14040:2006].
renewable energy	Energy from non-fossil energy sources: wind, solar, geothermal, wave, tidal, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases [Adapted from Directive 2001/77/EC, Article 2 [4]].
secondary data	Data obtained from sources other than direct measurement of the processes included in the life cycle of the product Note Secondary data is used when primary activity data is not available or it is impractical to obtain primary activity data.
situation awareness monitor	Elisa's data collection, aggregation and presentation system.
system boundary	Set of criteria specifying which unit processes are part of a product system [BS EN ISO 14040:2006].
upstream emissions	GHG emissions associated with processes that occur in the life cycle of a product prior to the processes owned, operated or controlled by the organization implementing this PAS.
use phase	That part of the life cycle of a product that occurs between the transfer of the product to the consumer and the end of life of the product Note For services, the use

	phase includes the provision of the service.
use profile	Criteria against which the GHG emissions arising from the use phase are determined.
waste	Materials, co-products, products or emissions which the holder discards or intends, or is required to, discard.

2. Executive Summary

This document is the case report of the Envitori's Work Package 3 study (WP3). The EnviTori is project of the Flexible Services –program and it promotes a wider use of environmental data and information.

This study was made in the spring of 2010 with collaboration of study case partners who were: Elisa Oyj, E.ON Kainuu, Natural Interest Oy and Sokos Hotel Vuokatti.

The main objectives of this study were to find out how an environmental information such as green houses gases can be measured and presented as CO2 footprint values, what is environmental information marketplace and what kind business interest, technical questions and legislation lies behind the environmental information services.

The secondary objective was to create an environmental information marketplace for the case pilot. How ever the case study time and lag of resources forced this study output to focus more in the research questions set by S-hotel Vuokatti: What is the carbon footprint of a quest night.

It was decided that the technical documentation of the environmental information marketplace is left out of this study and handed over to be documented by the EnviTori Work Package1.

This study report contains totally twelve chapters. The chapter four describes the case partner roles and interests in this study more deeply. The chapter five outputs the overall process of assessing the emissions and CO2 footprint using GHG and PAS 2050 protocol guidelines used in this study and is fully written by Natural Interest.

The chapter six discovers how the S-hotel Vuokatti carbon footprint was calculated from manually given input values provided by S-hotel and E.ON Kainuu from their background systems.

The chapter eleven discovers the key factors and the outcomes of the study. The Carbon footprint of a guest night amounts to around 16 KgCO2e per night. In line with other carbon footprint studies biggest impact was from utilisations (electricity, heat and water).

Previous study by Natural Interest showed that an average Swan labelled hotel averages around 22 KgCO2es per quest night meaning that S-hotel had a lower footprint. How ever S-hotel did not measure their use of chemicals. Carbon footprints therefore in this study are not directly comparable

The chapter twelve points out some important study findings by case partners, discovering the need among the customer for the environmental data and the challenges of automated data gathering.

3. Introduction

Climate change and greenhouse gas emissions are hot topics among the general public, and pertinent discussions are taking place at corporations in today's technologically advanced business environment. The importance of sustainability and environmental issues has become crucial as stakeholders and regulators are paying more attention to the overall impact of emissions and environmental impact of companies' and their operations.

Organizations are increasingly required to measure the sustainability and impact of their work. The CO2 footprint is a popular indicator for measuring, monitoring and managing environmental sustainability. The CO2 footprint refers to the total set of greenhouse gas emissions caused directly and indirectly by the organisation. The footprint encompasses the total amount of CO2 and other greenhouse gas emissions for which an individual or an organisation is responsible.

The CO2 footprint is included in corporate reporting for various reasons. Major reasons are stakeholder and customer demand for accurate and transparent reporting and the tightening standards of regulations. Companies are also looking for ways to manage their footprint and monitor and reduce emissions over time, as they can be a source of cost reductions. Through accurate and detailed environmental impact measurements companies can assess not only their environmental impact but also the efficiency of their current resource usage. Other reasons for managing a company's impact on the environment include reducing consumption, waste and pollution, meeting legislative targets, lowering expenditures, and improving stakeholder and customer relations. It is clear that the worldwide policies and legislations regarding to CO2 reporting will become the vital ground that will guide the course of the next-generation business and corporations.

3.1. The Carbon foot print as in business case

Carbon footprint calculations of operations, products, services and supply chains are integral part of low-carbon economy.

For S-hotels carbon foot printing model is developed to provide a sophisticated carbon accounting package which can be used in-house by the organization to provide detailed, diagnostic footprint outputs. This capability will enable S-hotels to use the results to develop targeted carbon reduction strategies, prepare comparative scenarios on an ongoing basis and communicate results to a wider audience.

The EnviTori project strives for a common way of sharing environmental data, and enabling new kind of service creation and initiation based on the shared data.

EnviTori studies the factors of defining and making environmental information service market: what kinds of data are available from public and private data providers, what are the meaningful environmental information services for users, and how enterprises can exploit environmental information in business?

The WP3 business case concentrates on a service that evaluates and assesses carbon dioxide emissions from companies' operations and their supply chain in order to make business decisions based on the CO2 data.

3.2. The key question in EnviTori program and the project focus in WP3

The key question in the EnviTori program and the WP3 is how to find a way to share, combine and process environment related information in a way which would give more value to Consumers. The value generated to the Consumer can either directly give informative value to Consumer processes, or would indirectly be experienced by a Consumer in form of better quality in services provided to the Consumer, or wholly new kind of services available for the Consumer.

Another motivation for increasing the transparency and amount of information is to support the possibilities for Consumers to make decisions based on product and service environmental performance.

In the WP3 the focus was set to study the processes of enterprises, and to find ways for service and product providers to utilize environmental related information in generating new business opportunities or to improve the present service or product quality.

The definition of term environmental information was discussed and it was understood that relevant information from the business perspective can either be information regarding the natural environment condition parameters, or parameters derived from the natural environment conditions. When building up a technical platform for environmental data market place, the platform can well be utilized both for sharing direct observations of a natural environment or parameters derived from it. An example of this issue came obvious in the case of Vuokatti area when considering the service provider processes. To secure flexibility and "just on time" efficiency in the leisure time activities services, the service provider can estimate the magnitude of the demand side as a function of natural environment conditions (temperature, wind, etc.), but also the amount of tourists in the hotels and the demographic and nationality distribution is relevant information. When knowing the natural environment parameters (temperature, rain, etc., and when knowing the booking-rate of the local hotels and some background information about the tourists, it can be estimated how large demand for some special leisure time activities can be.

When the environmental information helps the service providers to generate better quality in the services, the customer does not necessarily need to know about the environmental information market place behind the good quality.

More straight forward application of an environmental information market place would be simply sharing the observations and prognoses of the natural environment parameters, or the environmental performance of the enterprises.

The WP3 project first focused on the definitions and abstract model of the environmental data sharing and market place. The case study required a concrete business environment where environmental information has got a direct linkage to the business processes. When finding an interesting area in Vuokatti leisure activities area, the issue came to find the parameters and forms of information which are valid for the enterprises in the area. Sokos Hotelli Vuokatti offered an interesting case for the study, when having modern hotel infrastructure and intentions to improve the imago of the hotel in term of environmental performance transparency and performance it self.

The vision built for the Sokos Hotelli Vuokatti or the Vuokatti resort area in general was that the Consumer may plan his/her vacation activities better when receiving more information about the natural environment conditions. Additionally the Consumer would receive feedback from the environmental performance of the services he/she had utilized during his/her vacation time. If the vision would be true, it obviously would have a wide impact to the whole Vuokatti area imago as a green and environmental friendly resort area.

To become true, it would require a wide commitment from the different service providers in the area. And to reach that, it needs decent and feasible technical solutions and a common vision which is easily to be adapted to the business needs of the companies. The easy and concrete utilization opportunities are the fuel for getting the commitment deeper among all the actors.

Sokos Hotelli Vuokatti took the first steps towards this scenario by starting to define the internal processes and external energy consumption and the environmental performance of the hotel activities. If one builds up a platform and information gathering processes for some environmental parameter, not only the processes eventually can be utilized in other companies also to widen the amount of information in the service, but also the same procedures and technology could be utilized for other environmental parameters also. In the WP3 the parameter was chosen to be CO2, because the definition and importance of that parameter is widely understood, and it is relatively easy to be communicated.

The primary objective of the project is to investigate and determine the feasibility of providing services to companies for identifying, calculating and reporting the amounts of CO2-emissions caused by their business activities. This involves evaluating the viability of providing CO2-related services by using an innovative technology solution in terms of market potential and profitability.

The goal of the project is to study a platform for providing technology-enabled service (a software solution) for companies to help them collecting, measure and report the CO2-emissions from their operations and activities.

A consumer survey was executed in the area concerning the possibilities of utilizing the environmental data and dialog with the local companies was risen to increase the understanding and commitment to participate the project. Finally the outcome of the project was a theoretical model of an environmental market place in the area, increasing understanding of the motivation factors among the consumers and service provider companies, and some concrete steps taken by one pilot hotel towards sharing and processing the environmental data.

4. Description of the study environment

This chapter discusses the case partner roles generally and the expertise's and interest areas in this study.

4.1. Case partners driving factors

Companies have several driving factors common to them all: effectiveness, resource optimization, profitability, share capital value, capital and risk management. In order to get companies truly interested in environmental issues related to their operations, there must be a ways to verify synergy between ecology and profitability.

4.1.1. Elisa

Elisa has developed a method for finding out and combining common profitability models within cross-sector companies, which can be linked to environmental issues. In EnviTori this synergy is looked through ICT and how it can contribute to an overall reduction in energy demand.

Elisa's interest in WP3 were more in the technical questions as: In what kind form the initial data are presented from the source systems, what are the data transportation mechanisms provided by case participants and how this mutual data can be shared in uniform way to the marketplace through the Situation Awareness Monitor - Server. How ever the latter stayed in lesser focus because of the short execution period.

Other aspects were to study what kind an environmental data the participants are ready to share for the marketplace and utilize from the marketplace.

4.1.2. Natural Interest

Natural Interest assess the possibility of building a B2B service applying CO_2 data to provide a service that will enable the companies to evaluate and assess carbon dioxide emissions from their operations and their supply chain in order to make business decisions based on the CO_2 data.

The planned service will enable a company or an organization to evaluate and assess their greenhouse gas emissions and act on these emissions by improving business processes and resource management. The intention of the service is to empower the users to find opportunities for energy, waste, material and emissions reductions and draw their attention to financial returns on investment in efficiency.

The work also has platform dimension; it wants to provide a platform for the user to look at the efficiency of their own organization and even that of their supply chain once information stored in "EnviTori" on company carbon footprints becomes more comprehensive.

4.1.3. EON Kainuu

The main product for EON Kainuu and other energy companies is energy and energy delivery in different forms. The product has got some special features; it does not smell or taste, it is used as a raw material or a source of the critical conditions light and warmth. Additionally the environmental impact is radical – over 80 % of all the green house gases in Finland are emitted in the energy production. The consequences of the energy production are not clear for the energy end users. The green house gas emissions are only one impact from the energy production: the transport of the fuels, the sulphurs, small particles and nitrates are a big problem also in the energy production and yet not often realized by the end-users. The connection between CO_2 and the greenhouse phenomena is widely understood. Therefore the CO_2 related calculations and information has got a strong communicative value. This offers a possibility to build up the reporting structures, procedures and routines for CO_2, which then can be widened to cover other emissions and eventually other environmental data.

Another interest is that if there were an environmental information bank with data from a very wide range of the society and industry, it would make it possible to make a calculating model for different companies to calculate their environmental impact. The more precise feed-in-information one could give to the mode, the better quality information the model would give. If this could be done in a sophisticated and reliable way, the internet portal might become also as a reference page, where to companies could give a link, and where the consumers might check the transparent calculations for the different companies. Many companies do not have a clear picture of the total environmental impact, and a standardized calculation model could be a good tool for this. There are ways of calculating the CO2 foot print, but one should see this question wider, as an environmental impact in a more general perspective. The energy company interest would arise partially from the fact that if a customer company would become more interested about the footprint, it would make it more relevant to discuss the opportunities of providing more environmental friendly energy. Another source of motivation is that the energy distribution companies already base their business cash flows on the energy measurement data. This same data includes potential for developing it further to a format which gives additional value for the customers. By linking the already measured information and rapidly developing energy information delivery technology and some information related business needs may open new business opportunities for the energy companies also. These needs on the customer side may be related to the aim to perform energy saving projects or to analyse and communicate the environmental performance of the business. The energy companies traditionally are focused on developing the hard technology to full fill the requirements of energy distribution and measurements. The requirements for increasing information delivered to the customers and to the authorities drives further the development of the measurement and data gathering technology, but it mainly is related to secure and full fill the new requirements of the present business operations. Understanding the opportunities in going further in the value chain by developing the information to give additional value to the customers is a challenge for the traditional energy companies.

4.1.4. Sokos Hotel Vuokatti

Sokos Hotelli Vuokatti and the background organization Osuuskauppa Maakunta drives sustainable development both within its own business sector in S -group and in larger perspectives in Kainuu area forums. Energy efficiency is a key factor for service provider to make profits in daily business. Studying of how these sustainability aspects, energy efficiency and end-user services can be tied down in a profitable way is Sokos Hotelli Vuokatti´s main research question. Data automatization models regarding to CO2 factors and making these factors visible in daily business is a competition advantage when compared to other hotel service providers. Data integration models are essential in developing localized service concept for sustainable growth areas.

4.2. Perspective of the environmental information by Gemic

The common meaning of environmental data and information was first studied through customer survey to 29 crossindusty corporations by Elisa (Pihlajarinne and Pispa, Elisa). Results can be tighted to 5 main themes: recycling, material selection, logistics, energy and messaging. Also business and customer requirements are clearly pointed out, although also from "negative" point of view; no business interest and profitability can be found in green issues. Also green is often seen more as an imago issue than as a real sustainable development.

Further on, Gemic conducted a user research (Ympäristötieto Vuokatissa, 19.2.2010, Suikkkanen, Gemic) at Vuokatti area in which they used ethnographic method. This survey is opened up in more detail in Envitori WP2 results.

Based on this survey, ecologicality is often seen as one form of environmental data, and it tells about good taste and social pressure. At home circumstances, ecologicality is part of daily functions, but the holidays (and thus hotel resorts) are not daily functionalities.
Awareness is rising and ecosymbols are considered important, especially visible things like carbage sorting, recycling and concrete things that make ones own consumption visible.

The user research outlined both customer and corporate viewpoints to environmental information, and to its importance and meaning.

According to Gemic's research on environmental information two actors and their different aims must be separated: the customer and the business actors and their relevant perspectives to useful environmental information. The information relevant to the daily lives to these two actors are different as they support their everyday aims and actions in different ways.

First, the customer perspective (Fig. 1.) to the environmental information relates to the aims of and to the actions performed while on holiday. Here, according to the field research done among Vuokatti customers and employees, the relevant environmental information relates to other people (who else is having holidays and what can you do with them) and to the environment, both built and natural (Where are the locations of interest in nature in the Vuokatti area? Which of them are right just for me regarding the skill level required for physical activity, the aesthetics of the place, reservation of the tennis courts etc? What is the built environment in and around

Vuokatti are and what can you do in these? How does the activities performed relate to consumption and natural resources such as energy, CO2, etc)?

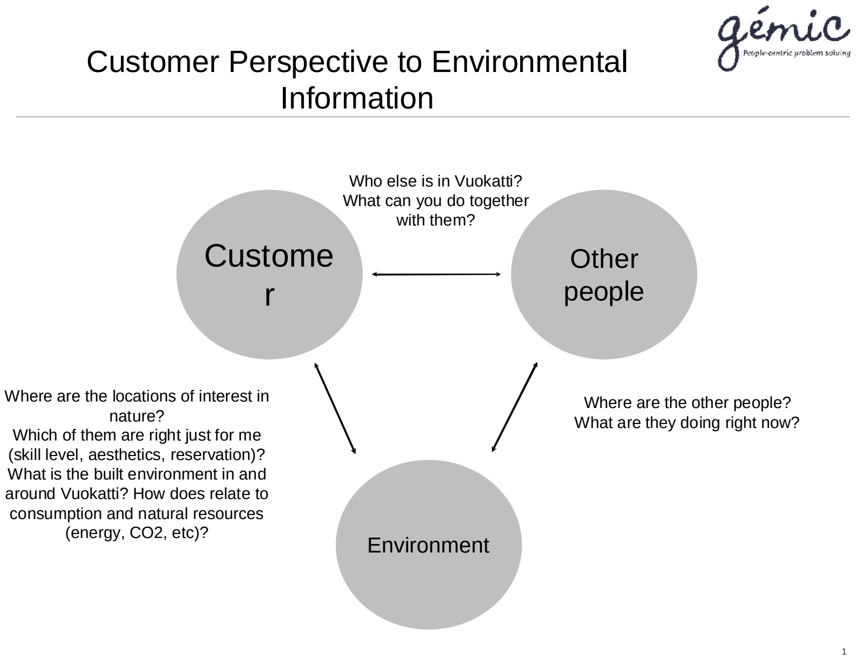


Figure 1. Customer perspective to enviromental information

Second, from the business perspective (Fig. 2.) the environmental information relates both to the resource optimization such as water and energy consumption, CO_2 emissions and the capacity utilization rate of the premises. This should guide the development of the selected indicators and the metering of environmental resources for business benefits.

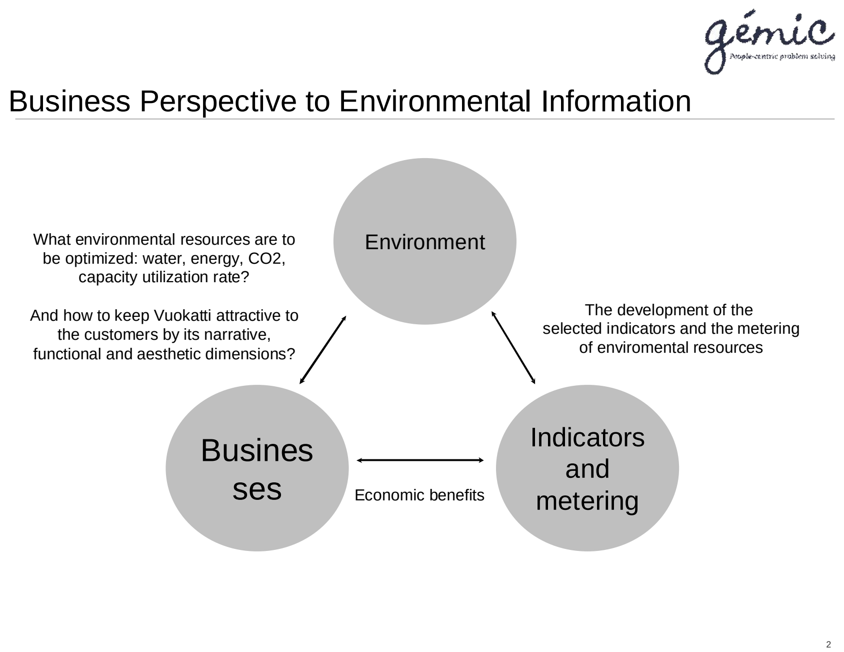


Figure 2. Business Perspective to environmental information

The challenge faced with the development of the Vuokatti area relates to the mutual development of both perspectives and their aims (Fig. 3.), and finally, their incorporation to a coherent framework and communication strategy to customers at large. How, in what ways, is Vuokatti an environmentally friendly place for having holidays and how this is communicated to the customers in order the create new value for both the business of the area and visiting customers alike?

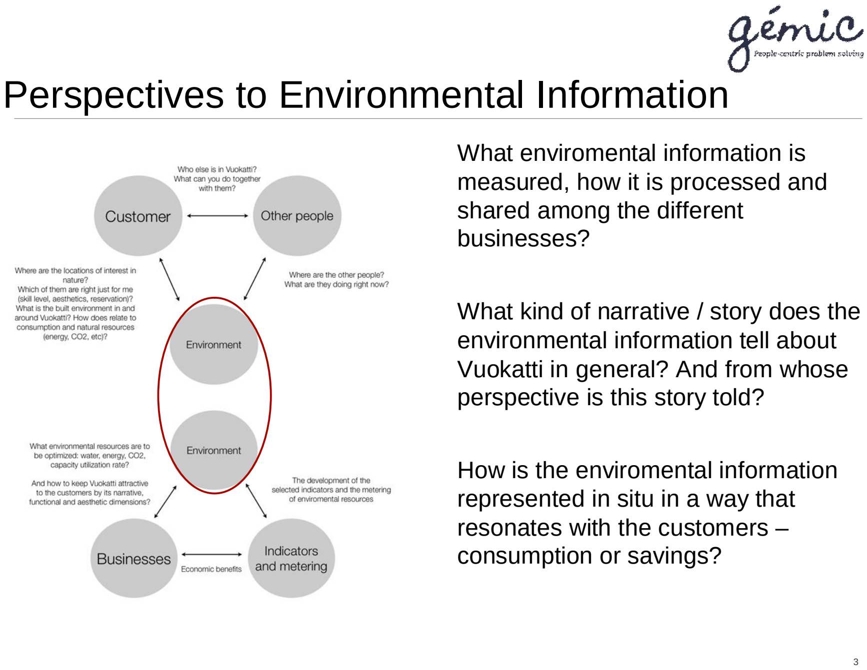


Figure 3. Perspective to enviromental information

Combination of the previous two should answer to Envitori´s main research questions, and to case specific reach questions: How can enterprises exploit environmental information in business? How can different issues/value chains/parts of companies that have an effect on environmental impacts be made visible? e.g. where is the energy a critical factor?

4.3. Sokos Hotel Vuokatti and EON information sources

The operation of Sokos Hotelli Vuokatti started in 2007. It has been equipped with a remote read electricity consumption measurement for the whole time of the operation. Additionally the district heating company VAPO has had a modern district heating measurement. In the following picture (Fig 4.) is presented the electricity consumption data on a hourly basis from the beginning of the operation.

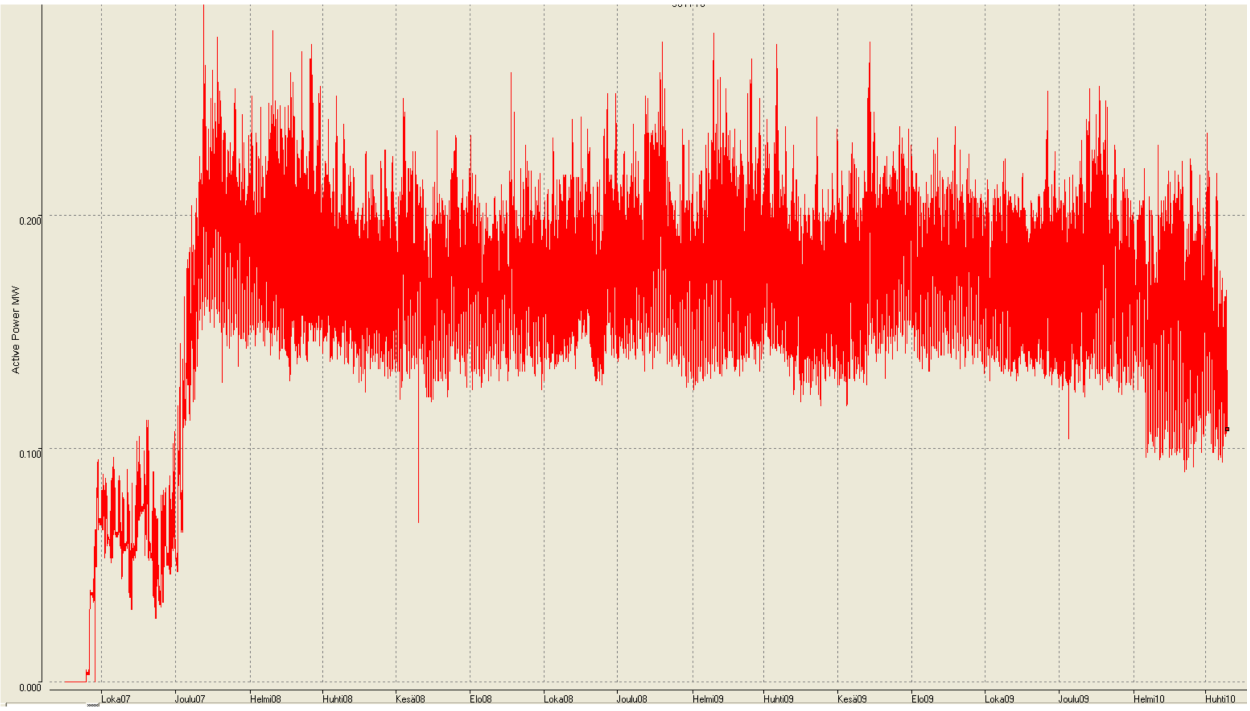


Figure 4. Electricity consumption data of S-hotel on a hourly basis from the beginning of the operatation

The both measurements for the electricity and district heating are the basis for the invoicing. Therefore the routines, procedures and measurement equipment quality have to be on a high level. The reliably measured data from the history is a basis for all the actions concerning all the projects related to the more efficient energy usage. The challenge in this is to make the information easily available in such a format which is easy for a Customer to utilize in communicative needs or for further development.

E.ON Kainuu Oy has done development work in providing reporting tools for the customers related to the energy usage. The electricity usage information has been the primarily target. Within this WP3 study the reporting was widened to the district heating energy also. The following graphs (Fig.5 and Fig 6.) are the daily electricity and district heating energies for Sokos Hotel Vuokatti for the year 2010. The district heating measurements were received to this reporting tool in February. The information time resolution can be chosen from hourly data to monthly.

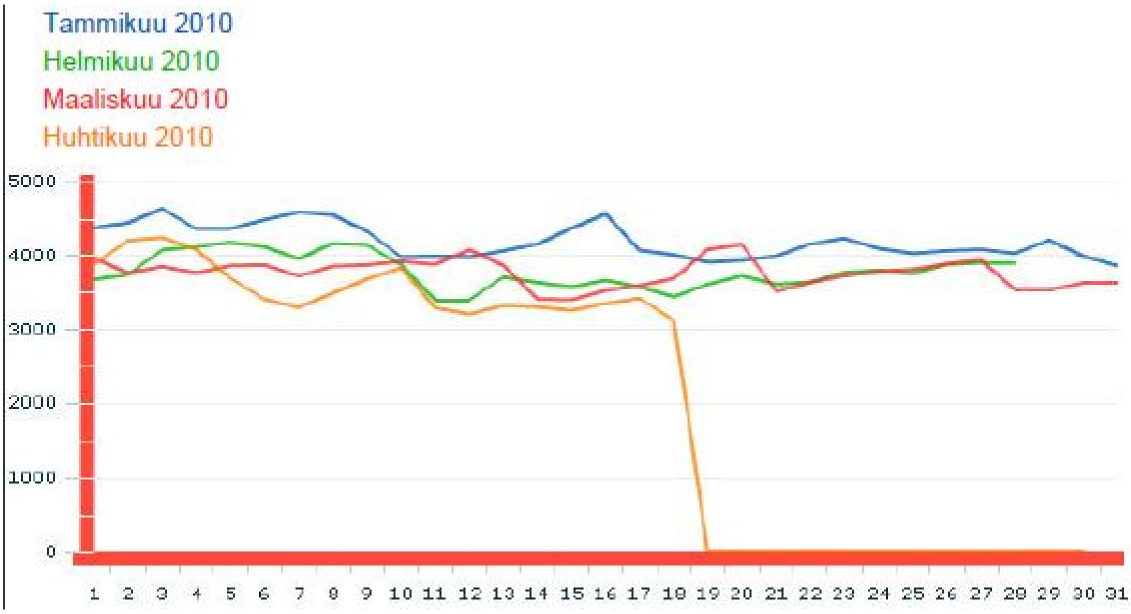


Figure 5. The daily electricity consumption of Sokos Hotelli Vuokatti in the year 2010.

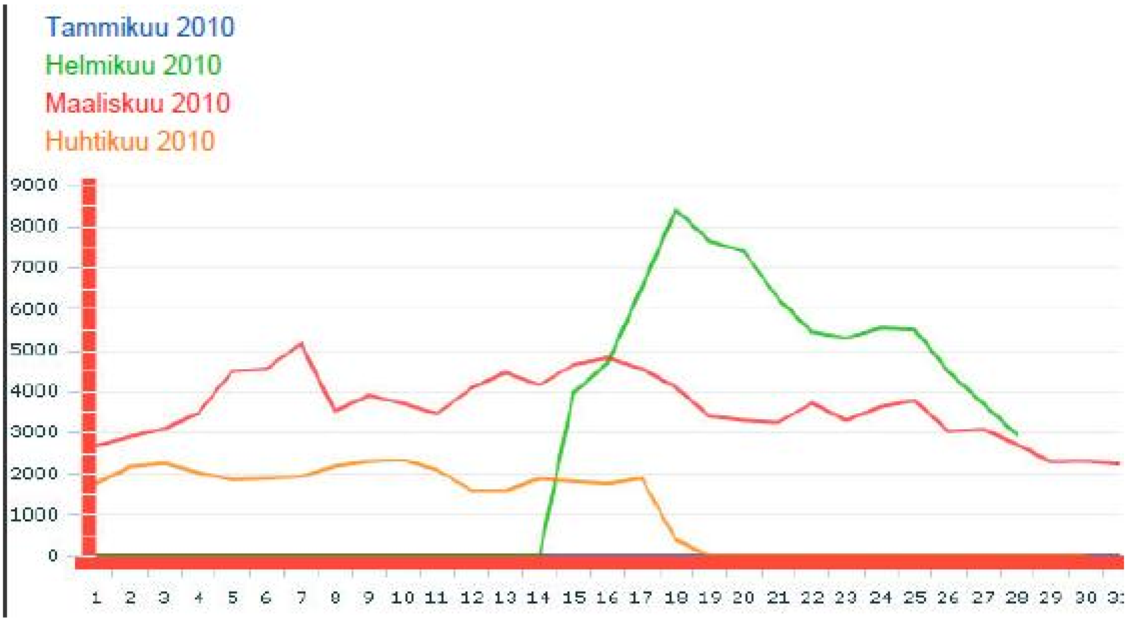


Figure 6. The daily district heating consumption of Sokos Hotelli Vuokatti in the year 2010 starting in the middle of February.

All the reporting tools and data transmission developed for the electricity distribution operation needs may be utilized in other measured information also. The systems most often do not care what information is transmitted and reported. Therefore it was an interesting and useful pilot case to widen the reporting tool also to the district heating. One practical issue had to be taken into account when utilizing the reporting tool for district heating. For district heat there are other measured parameters also than only the energy. For a customer it is interesting to follow the in coming water temperatures, out going water temperatures and the water flows. All this information was also added to the reporting tool, which caused some practical issues to be solved.

For this WP3 project was provided the historical hourly consumption data of the hotel building electricity usage. The historical district heating figures were provided by the invoices from the district heating company, but in this project was developed a hourly measurement data gathering of the district heating information to the same reporting tool as the electricity. By reporting the electricity and district heat, can be then gathered a major part of the CO_2 emissions related to the hotel operation. Parallel to this was the building automation system developed to gather also the district heating data to the system. The building automation system includes major potential in gathering and providing all the measured data concerning the building. It includes the indoor and outdoor temperatures and water consumption data also. The interfaces from the building automation system to other systems in a data cloud may be a challenge though.

The concrete target for the WP3 was to have already a pilot version functioning concerning the data gathering and further calculations of environmental factors. In principal it would have been possible from the energy usage side to proceed further in horizontal and vertical direction. By this is meant to proceed further and deeper in the Sokos Hotelli Vuokatti energy consumption measuring, to divide the whole consumption closer to different services and processes running in the hotel building. It would have given possibilities to allocate better the total CO_2 emissions to different service products used by a customer. By saying that the measurement data gathering could have been also horizontal, meaning that there are no technical constrains to combine not only the energy usage of Sokos Hotelli Vuokatti but also the energy usage of the major service providers nearby to the same calculations. It would then give more information about the services the hotel buys or the services which the hotel customers use when staying in the area.

The reasons why the hotel energy consumption was not studied deeper or measured in a more detailed way was that the effort was first put to get the main energy measurements for the district heating and electricity to the E.ON Kainuu Oy reporting system, which allows the customer to follow up the hourly energy consumption. It was recognized that there are possibilities for sub measurements in the building for the energy, but it was recognized to be one of the next steps after the more critical issues from the data gathering perspective are solved. Attaching other companies in the area or nearby to the data gathering is technically simple issue, when having all the measurements in the automatic measure reading system, and basically all the data in the same data base. During the WP3 work, there were no success in getting commitments from the companies to commit to this project. The main reason for this is interpreted as: at the moment in the area are several projects dealing with sustainable development, having more concrete imago building or technical solution targets, and those projects have absorbed the limited resources in the companies.

4.4. The vision of environmental information marketplace by Elisa

Elisa's first interest in this case study was accomplish a technical implementation of environmental information marketplace and pilot it with WP3 case partners.

The vision of the environmental information marketplace by Elisa can be presented as follows: The marketplace is a virtual place of business build up from network of systems witch collects, refines and shares environmental information such as electricity consumption, wind direction and speed, temperature, CO2 footprint and etc., that can be used to build up for a new services of environmental business.

The marketplace can perceive as a plaza where environmental information data articles are the products to sell and buy. The plaza customers are those who creates an environmental data for the virtual marketplace and those who consume that data for creating end-customer business applications. One can also fetch the data from the marketplace, refine it for example by adding metadata in it and then placing the data back to marketplace with a new selling price.

The main feature of the marketplace (Figure 7.) are the common rules witch defines the application interfaces, protocols and network systems agreed by the marketplace founders. Following these rules, the users of the marketplace knows how one can push an any information to the marketplace or how the data is published for example using a some kind directory services or internet catalogue. The common rules also specifies how the information is found by the other marketplace users. In the vision the marketplace has also an ability to keep a history of the evaluation of the data and offer pricing mechanisms for the data.

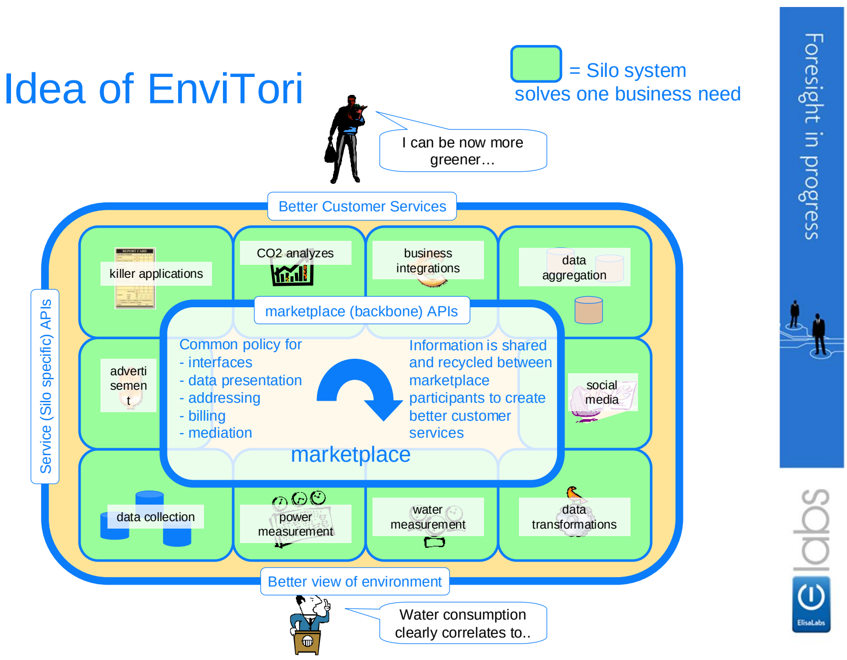


Figure 7. The idea of the Market Place

In this case study (WP3) the first planned goal was to produce an example of the marketplace and its rules in and technical details by the use. The marketplace pilot was planned to consist of the information sources provided by the S-hotel's customer resource management systems and energy information produced by E.ON Kainuu and Natural Interest's CO2 footprint calculation system and Elisa's Situation Awareness system.

In the above plan the participants systems are connected so that the NI collects the S-hotels consumption data through the marketplace so that the NI may calculate the S-hotels real time CO2 footprint information. Then this calculated data is pushed back by the NI to the marketplace for the Elisa use so that the situation awareness system may present this data over Kainuu area map for customers.

This Elisa vision stayed for undone because of the WP3 tight schedule and lag of resources. How ever, there is a technical document about the marketplace vision, including all the technical details and the state of art design of the environmental information architecture created by Envitori WP1 group.

The WP3 decided at very early stage that group will focus more the overall processes and policies of assessing the emissions and CO2 footprint than the technical details of the marketplace.

5. Overall process of assessing the emissions/co2 footprint

Historically there has not been a single, consistent and internationally agreed method for calculation and reporting, and therefore can be difficult to compare published footprints. In this study a combination of two guidelines was followed, GHG protocol and PAS 2050.

The Greenhouse Gas Protocol (GHG Protocol) is the most widely used international accounting tool for government and business leaders to understand, quantify, and manage greenhouse gas emissions. The GHG Protocol, a decade-long partnership between the World Resources Institute and the World Business Council for Sustainable Development

The British Standards Institution (BSI) has published a relevant Publicly Available Specification, known as PAS 2050 'Specification for the assessment of the life cycle greenhouse gas emissions of goods and services', sponsored by the Department for Environment, Food and Rural Affairs (Defra) and the Carbon Trust through an open and consultative process. This method offers a robust, consistent approach to calculating carbon footprints for individual products and services, adapting existing life cycle analysis standards to create a full measure of product-level GHG emissions.

5.1. Carbon accounting principles

GHG protocol has outlined that GHG accounting and reporting shall be based on the following principles:

5.1.1. Relevance

GHG requirement: 'Contains the information that users, both internal and external, need for their decision making… An important aspect of relevance is the selection of an appropriate boundary.'

5.1.2. Completeness

GHG requirement: 'All relevant emissions sources within the chosen inventory boundary need to be accounted for so that a comprehensive and meaningful inventory is compiled. In practice, a lack of data or the cost of gathering data may be a limiting factor'

5.1.3. Consistency

GHG requirement: 'Users of GHG information will want to track and compare GHG emissions information over time in order to identify trends and to assess performance8.'

5.1.4. Accuracy

GHG requirement: 'Data should be sufficiently precise to enable intended users to make decisions with reasonable assurance that the reported information is credible.'

5.1.5. Transparency

GHG requirement: 'Transparency relates to the degree to which information on the processes, procedures, assumptions, and limitations of the GHG inventory are disclosed in a clear, factual, neutral, and understandable manner.'

5.2. Process

Almost all the products and services that we consume are responsible for causing carbon dioxide emissions, either through direct emissions across the supply chain or in the energy required for their production, transport and disposal

Many of today‘s products are supported by long and complex supply chains, making accounting for their GHG emissions along the product‘s or service's life cycle challenging. Even a simple product such as bread has its GHG emissions spread across farms, mills, bakers, retailers and transport providers which may or may not be part of one company or corporation. Additionally, these activities may or may not take place in the same country. Finally, the company needs to consider the downstream emissions of the bread due to its purchase, consumption and disposal.

Depending on an company‘s position in a supply chain, a portion of the product‘s life cycle emissions has occurred prior to their involvement in the life cycle, while the remainder of life cycle emissions will occur subsequent to their involvement in the product‘s life cycle. In case of S-hotel Vuokatti emissions from materials and food stuffs have occurred prior to S-hotel involvement. Subsequently emission from waste occur after S-hotel involvement, in the disposal and recycling phases. However, total carbon emissions from waste differ greatly depending whether embodied carbon emissions of waste materials is considered or omitted. Materials and waste have a big impact on carbon footprint of a hotel guest and emissions from the supply chain of these categories should be considered in emission calculations.

(In this study data from service and material was not collected directly thus they did not provide primary data information of their GHG emissions to support the calculations, this approach however should be considered in the future.)

5.3. Defining the Functional Unit

To begin understanding how to calculate the emissions of a product, the company first defines the functional unit. The functional unit is the quantified performance of a product system for use as a reference unit (BS EN ISO14 14044:2006, 3.20), and establishes the basis for which the GHG inventory is calculated and reported. The functional unit is necessary as it is the reference against which all relevant inputs and outputs of the product system are normalized. A functional unit is particularly useful for comparisons between products and services that provide the same function.

5.3.1. How to define the functional unit

How a company defines the functional unit may vary depending on the material or product of interest and to whom the results are communicated. Regardless, the following elements need to be addressed when defining the study‘s functional unit:

- The quality of the product
- Service life
- Use Patterns
- Technical performance characteristics and maintenance requirements
- End-of-life of the product (e.g. availability of recycling infrastructure and ultimate fate of material(s), components or subcomponents)

5.4. Boundary settings

Determining the boundary of the product or service system is an important step in performing a carbon footprint inventory, as it defines the bounds for data collection. Additionally, rigorous and well defined product systems are necessary to meet the standard‘s goal of public reporting and disclosure. A life cycle consists of consecutive and interlinked stages; within each stage, processes that are attributable to the function of the studied product or service are considered within the product system boundary.

Requirements

A company shall map the life cycle of the service from material acquisition through to end-of-life and disposal. This is referred to as a process map. Companies shall perform full life cycle GHG inventories (cradle-to-grave) for all services when applicable.

Processes that are attributable to the function of the service shall be included in the boundary of the product system. These processes are directly connected over the service‘s life cycle by material or energy flows, from extraction and pre-processing of service components through to the service‘s end-of-life.

5.5. Process mapping

A process map identifies stages and processes throughout the service life cycle. A company should track wastes, possible co-products, and component inputs within the process map. However, as specifics about the processes and inputs of a service may be considered confidential, a company may report a generic version of the process map. At a minimum, the reported process map should make clear:

- The flow of a service (and its components) through its life cycle
- The life cycle stages considered in the study

An example of a product system is given in figure 8.

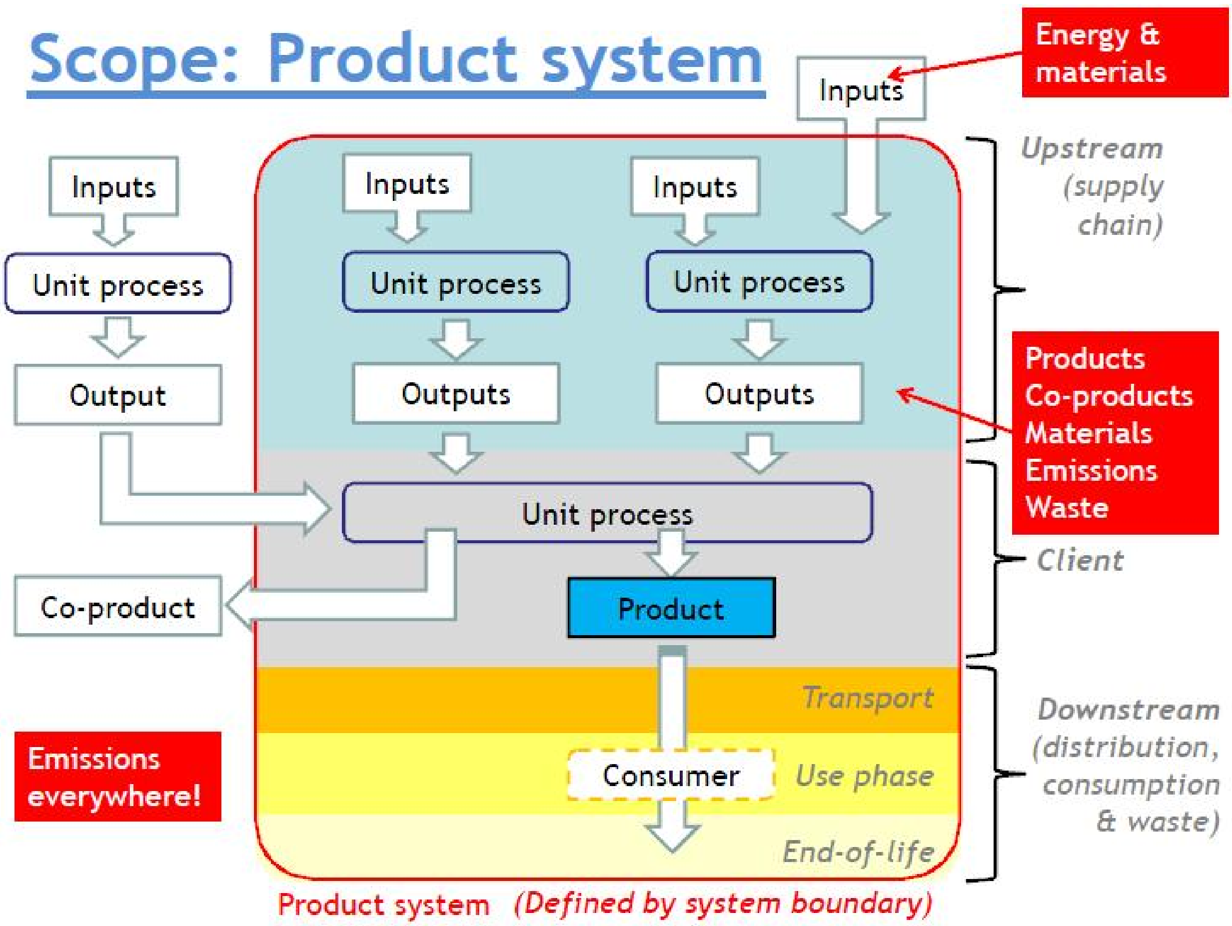


Figure 8. Illustrative example of a product system

5.6. Data collection Considerations

Data collection should follow the GHG Protocol principles of accuracy, completeness, relevance, and transparency to ensure a true and fair account of a product GHG inventory.

The system boundary defines the processes and inputs that data is collected for.

Primary data is collected for all significant processes under the financial or operational control of the company undertaking the product inventory.

Every effort should be made to collect good quality primary data from suppliers.

Comparing primary data to secondary data may be used to check the validity of the collected primary data.

Data should represent as closely as possible to the time, geography and technology of the relevant inputs/processes.

Time, expense and accuracy may need to be considered when collecting information. Therefore, more effort should be put in improving the accuracy of larger emission sources.

5.7. Types of data

Primary data: relates to activity data, emissions factors, or direct emission measurements for a specific process related to a specific product manufactured by a company or another company in its supply chain. Site specific primary data come from the production sites associated with the processes within the system boundary. They include emissions factors for activity data and/or emissions.

- Direct measurement
- Normally from own operations only
- For example: liters of diesel, kWh of electricity

Secondary data: relates to activity data, emissions factors or direct emissions measurements for processes related to a specific product that are not directly measured by the reporting company or a company in its supply chain. Secondary data may be process data or non-process data (e.g. environmentally extended input/output data).

- Emission factors (convert activity go GHG's)
- From other sources e.g. 3rd party databases
- For example kgCO_2/kWh of electricity

Process data: physical flow data relating to the individual process within the defined system boundary, and may consist of site specific primary data, generic/average secondary data, and secondary data from literature studies, expert estimates, and impact assessments

Input-Output data: Non-process data derived from an environmentally extended input-output analysis (IOA), which is the method of allocating GHG emissions (or other environmental impacts) associated with upstream production processes to groups of finished products by means of inter-industry transactions. The main data sources for IOA are sectoral economic and environmental accounts. Economic accounts are compiled by a survey of facilities on economic inputs and outputs and tax data from individual establishments. Environmental accounts are derived from (surveyed) fossil fuel consumption by industry and other GHG sources compiled in national emission inventories.

Extrapolated data: Primary or secondary data related to a similar (but not representative) input, processor activity to the one in the inventory that are adapted or customized to a new situation to make more representative. For example, using data from the same or a similar activity type and customizing the data to the relevant region, technology, process, temporal period and/or product.

Proxy data: Primary or secondary data related to a similar (but not representative) input, process, or activity to the one in the inventory, which may be used in lieu of representative data if unavailable. These existing data are directly transferred or generalized to the input/process of interest without adaptation.

6. Process of selecting the key factors in this study

Calculating a carbon footprint for products and services can be quite a complex. However it is clear that when calculating a footprint it is important to try and quantify as full a range of emissions sources as possible in order to provide a complete picture of the total impact.

6.1. Case Response to GHG Accounting Principles

6.1.1. Relevance

The boundaries of S-hotel footprint methodology were selected so as to include those elements over which the hotel has influence and/or control.

6.1.2. Completeness

Previous experience from Natural Interest and their associates Best Foot Forward in carbon footprinting Swan labeled hotels and Intercontinental Hotel Group indicate that over 60 % of the carbon footprint is caused by energy usage (heat and electricity). Waste was identified as another big hitter. By

> **Carbon Footprint**
>
> 'The total set of greenhouse gas emissions caused directly and indirectly by an [individual, event, organisation, product] expressed as carbon dioxide equivalents (CO2e).'

including food stuffs it was considered that data collection covered over 90 % of the total carbon footprint for S-hotel. This data could be used to scale S-hotel, or any other footprint to cover 100 % of emissions.

On a more general level company-wide emissions from marketing, administration and other non-hotel activities should also be allocated into the carbon footprint a hotel stay. This was not possible in the scope of the study as it would require carbon foot printing all activities of S-hotel.

Due to limitations on behalf of S-hotels data gathering could not be broadened to cover all identified aspects of carbon emissions sources, however identified big hitters were covered.

6.1.3. Consistency

Our approach was to reflect the need for consistency over time by adopting clear reporting boundaries and a well-defined calculation method. However, this pilot case was more focused on creating automated data gathering than well-defined calculation method. Although we recognize that carbon accounting is an evolving discipline and that emerging new standards, guidelines or conversion factors may make changes in method necessary.

6.1.4. Accuracy

Data gathering focused on historical, documented consumption data on all categories and fulfills the accuracy principle.

Calculation methodology is consistent with standards such as PAS2050 and GHG Protocol. Utilities emission factors were provided by Energiateollisuus ry. Emission factors for waste are from life cycle case studies. Emission factor ‘white papers’, which disclose underlying assumptions for selected emission factors are provided upon request for audit purposes.

6.1.5. Transparency

To make any limitation transparent, we have documented where methodology decisions were subject to any particular challenge, restriction or problem.

Collected primary data including occupancy rates have not been disclosed though.

6.2. Response to Boundary Setting and Process Mapping

Study boundaries were set to cover operations over which S-hotel had control over. This meant that the direct carbon footprint was assumed to cover CO2 emissions from heating, electricity, water, food and waste. Employee commuting was identified as CO2 emission and data sources but due to resource restrictions data was not collected for this study. Outsourced services, business travel and other logistics were identified as operations which S-hotel has control over, however data gathering was not possible due lack to resources. Customer travel to and from the hotel and land use changes were omitted from this study due to S-hotels not having any control over how customers traveled to and from to the site. Land use was omitted due to the nature of study. CO2 emissions were accounted only in the year they occur and no land changes took place during the course of the study.

Below is an illustrative representation of S-hotels direct carbon footprint boundaries (Figure 9.). Data was collected for categories in blue. Categories in white were recognized as CO2 emission and data sources but data was not collected. Categories in red were recognized as CO2 emission and data sources but were considered to be outside of carbon footprint of a hotel stay.

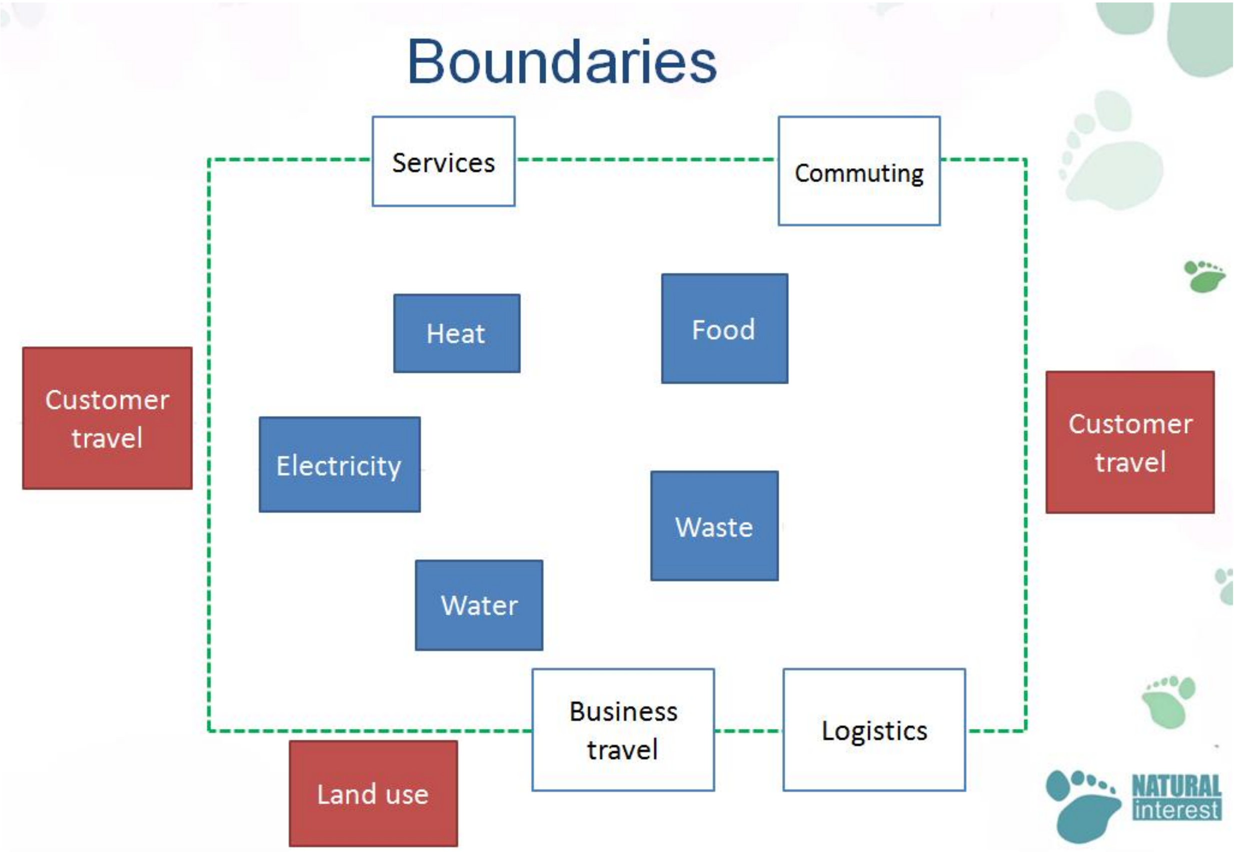


Figure 9. S-hotel Vuokatti carbon footprint boundaries

Only primary data was collected following the guidelines outlined in chapter 5. No other types of consumption data was collected.

6.2.1. Data Dype

Only primary data was collected following the guidelines outlined in chapter 5. No other types of consumption data was collected.

6.2.2. Defining the Functional Unit

S-hotelli Vuokatti's functional was set to a single guest night stay.

6.3. Response to Data Collection

Required data location and data type was identified together with NI and S-hotel.

Number of the hotel stays was reported by S-hotel. (set to *34720* guest nights)

Electricity data consisted total electricity consumption by the premises. Separate metering was in place for the hotel area and it determined the hotel area consumption covered *69,18%* of the total consumption of the building.

Heating data consisted total heating consumption by the premises. Separate metering was in place for the hotel area and it determined the hotel area consumption covered *69,18%* of the total consumption of the building.

Water data consisted total heating consumption by the premises. Separate metering was not in place for the hotel area, however it was determined that hotel area consumption covered *75%* of the total consumption of the building.

Waste data included all waste data for the . It was considered that *60%* of the total waste for incineration was allocated for the hotel. Subsequently *30%* of total biowaste and *40%* of total mixed waste was allocated for the hotel.

Food data was collected from procurement. Data was in kg's of food stuffs delivered to S-hotels annually.

Materials (such as furniture, bed linen, towels, chemicals, IT equipment, vehicles etc.) and transport data was omitted due to lack of resources in data collection. It was acknowledged that to calculate a full footprint this data should be collected in the future.

6.4. The basic calculations for a hotel are based on main sources of emissions

From the collected data carbon footprint of operations or products is compiled and analyzed. From the results companies can define customizable key performance indicators to focus on.

Formula 1. Calculating a carbon footprint of electricity

Annual Electricity consumption x emission factor = electricity carbon footprint

For example:

870 MWh x 0,163 kg CO_2/kWh = 142 tCO_2

Formula 2. Calculating a carbon footprint of waste

Amount of waste in kg's x emission factor = Waste carbon footprint

6.5. Primary data for a hotel includes

Activity data from inputs used to produce the specific product or service at the hotel site, e.g., kilograms of food consumed, liters of water consumed.

When collecting primary data there is a preference for the way the data is collected and used to calculate GHG emissions:

- Measured data, e.g., direct consumption data or GHG emissions measurements for the process at the hotel site.
- Calculated data, e.g., where activity data are collected at the hotel site and emissions factors are used to determine the GHG emissions.
- Estimated data, e.g., where consumption data or GHG emissions are available, but cover the whole hotel chasing and need to be disaggregated to a specific process/product

6.6. Lifecycle databases

Secondary data are typically sourced from existing lifecycle databases. Many such databases exist and they vary in their sector or geographic focus, their cost, frequency of update and review processes.

6.7. Emission Factors

Emission factors may be derived from any of the secondary process data sources. An emission factor is the GHG emissions per unit of activity.

There are two types of emissions factors commonly available. The first relates only to the activity causing the emissions (e.g., combustion of fuel) – activity emission factor. The other relates to the production of the inputs used in an activity as well as any emissions associated with the activity itself – lifecycle emission factor. Using a fuel example, the lifecycle emission factor would include not only the combustion of the fuel itself but emissions associated with the extraction, transport to refinery, manufacture of the fuel, and often the transport of this fuel from the refinery to the retailer.

For this study Natural Interest collected lifecycle data for waste and food stuffs from their existing database. Food and waste emission factors covered all upstream emissions as well as process emissions. Utilities emissions were annual averages for Finland for 2008. Utilities emission factors covered GHG emissions from combustion only, they did not include upstream emissions as described above.

6.8. Sub note of the Finnish legislation and data quality

There are both laws in the Finnish legislation (1129/2003 and 14.5.2005 statement) about the informing of the energy sources used in the electricity production. The information must be given for every product and therefore every customer should get the information about the energy sourced used for the electricity, and individual g/kWh or mg/kWh emissions. This information can be utilized in the CO2 footprint calculations also, but the procedure of the data gathering must be planned in a clever and reliable way. Additionally what comes to the district heating, or even more than in the electricity, the energy sources of the district heating can be reported. The district heating network is a monopoly, and therefore the energy sources can be reported with good data quality.

7. Outcome and validity of the selected factors and data in this case study

This chapter discusses validity of the data, data form, source and time frame. In general collected primary data (Table 1.) was in correct form for carbon footprint calculations and of excellent quality.

Table1. Primary data

Primary Data Type	Data Form	Data	Data Source
Electricity	kWh	Annual data	Billing, Electricity company
District	kWh	Annual data	Billing, Electricity company
Water	m3	Annual data	Billing, Electricity company
Waste	kg of waste	Annual data	Waste report, Waste company
Food stuffs	kg, litres	Annual data	Procurement

Utilities data was produced by utilities companies, however data had to be allocated for the hotel from total consumption of the premises. This reduced data validity but only by a small margin.

Waste data is more problematic. Waste amount is calculated based two factors. Number of times waste is collected and average waste container load factor. Waste is not therefore weighted but the waste amount is based on averages. Also, waste is reported for whole premises and it needed to be allocated for the hotel.

Food data also required allocation. It was also discovered however that food data included some minor errors, mainly from incorrect data entry in procurement. Data validity errors are usually caused by incorrect data entries, when a large volume of data is entered in a short period of time. In the case of S-hotels for example high milk consumption had been entered into 'cream'-section and vice versa. Food data validity can be improved by improving data entry procedures.

Table2. Secondary data

Secondary Data Type	Emission Factor	Source	Info
Electricity	gCO_2/kWh	Energiateollisuus	Finland's annual average 2008
District	gCO_2/kWh	Energiateollisuus	Finland's annual average 2008
Water	$gCO_2e/m3$	Natural Interest	Case Study
Waste	Kg CO_2e/kg of waste	Natural Interest	Case studies
Food stuffs	Kg CO_2e/food stuff	Natural Interest	Case studies

Secondary data (Table 2.), or emission factors, was delivered by Natural Interest. Utilities emission factors are based on annual Finnish averages and data was delivered by Energiateollisuus ry. In terms of electricity, according to PAS2050 guidance all upstream emissions should be included in the emission factor. However, this data is not commonly available in Finland yet. For district heating local emission factor should be preferred to Finland average and this process should be applied in the case of S-hotels in the future.

For water, waste and food stuffs general emission factor data is limited and rarely available for general use. It is very common to use general life cycle databases for this type of data. In this study Natural Interest's own database, which is based on different life cycle studies was applied to calculate carbon footprints for food stuffs. In the future emission factors for materials and food stuffs should be more commonly available and more transparent. It would improve the accuracy, help in benchmarking, reduce the costs, allow easier validation and audit processes and in general be more transparent.

Consumption data for materials is commonly harder to collect than information on utilities and travel. Often net spend is known but not the actual usage in terms of kg's of material.

7.1. The energy measurement data validity by law

The energy measurement data is relevant and valid for the environmental performance calculation. Energy production in a national level covers over 80 % of all the greenhouse gas emissions, and therefore leaving it aside would ruin the whole footprint calculation. The measurements must full fill the EU directive 2004/22/EY for measurements, and therefore their reliability must be audited and certified also. The data processes for electricity are the invoicing processes, and it therefore includes requirements for the validity. The district heating pulse taken from an other actors meter is also a invoicing measurement, so the pulse source must be considered as reliable.

8. Exclusions

Study boundaries were set to cover operations over which S-hotel had control over. This meant that the direct carbon footprint was assumed to cover CO2 emissions from heating, electricity, water, food and waste. Employee commuting was identified as CO2 emission and data sources but due to resource restrictions data was not collected for this study. Outsourced services, business travel and other logistics were identified as operations which S-hotel has control over, however data gathering was not possible due lack to resources. Customer travel to and from the hotel and land use changes were omitted from this study due to S-hotels not having any control over how customers traveled to and from to the site. Land use was omitted due to the nature of study. CO2 emissions were accounted only in the year they occur and no land changes took place during the course of the study.

Only primary data was collected following the guidelines outlined in chapter 5. No other type of consumption data was collected.

Materials (such as furniture, chemicals, IT equipment and vehicles) transport data was omitted due to lack of resources in data collection. It was acknowledged that to calculate a full footprint this data should be collected in the future.

Collected primary data was in general of excellent quality. However several exclusions had to be made due to lack of resources. Chemicals and material data was not covered. Comparing to previous studies these two categories generate roughly one fifth of a carbon footprint of a hotel. Logistics data was also excluded. On a more general level company-wide emissions from marketing, administration and other non-hotel activities should also be allocated into the carbon footprint a hotel stay.

9. Automation versus manual information gathering and delivery process of CO2 footprint

In order to produce a reliable footprint, it is important to follow a structured process and to classify all the possible sources of emissions thoroughly. Producing a full footprint can be a complex task. Furthermore, published footprints of different companies are rarely comparable due to different approaches and standards of measuring and calculating emissions.

Currently the CO2 footprint is calculated manually or automatically by individual people in companies, external consultants, or not calculated at all. Manually handled monitoring and tracking is very time-consuming and prone to errors. Using a software application to automatically handle data gathering, monitoring and tracking may improve the quality of reporting, while ensuring the accuracy of timely delivery.

Table 3. Key strengths of automated data

integrity	real environmental impact and accurate results
accuracy	reliable measurements and calculation processes
transparency	security of information and auditable means of gathering data
efficiency	less time, less labour, less costly methods of data extraction

The requirements concerning the energy amount and delivery quality measurements increase rapidly. The requirements for energy consumption reporting and consumption based monthly or even hourly reporting increases the need for developed data management systems. Additionally for example in the electricity distribution business the regulation model requires more and more data about the distribution quality, meanin the variation of voltage or the amount and length of disturbances. When all the other data management is planned in the automatic way, building the environmental footprint calculation or data management in manual way would not be in line with the general development. Nevertheless the energy consumption data is considered as private data in that sense that no third party is allowed to see or get the data without the permission of the consumer. This is a factor which should always be taken into account. This means two issues; the consumer must give a permission to the energy company to give the data to the environmental market place. The other issue is that the market price data management structure must be planned in a way that the data actually is used and spread in the way it was agreed. In this WP3 there was steps taken into the direction of gathering the data in a secure way. Sokos Hotel Vuokatti gave a permission to use the data in this project, and E.ON Kainuu Oy studied the possibilities to deliver the data. Even though not tested, the secured ftp push technology was interpreted as an option in the data transmission with a light infrastructure. The energy companies are not used to give permission for any actor to take data from the measurement data bases, rather is seen better a operation where the energy company sends the information. It most likely is possible to find more sophisticated ways of data transmission, when the security issues are solved in a decent way. When the study scope was only one company, the mandate of using the data was easily solved. But if there were for example hundred consumption points in the area, with changing owners or changing views whether to be or not to be in the environmental data gathering, it is also a challenge to manage whose data can be taken and whose data should not be taken into the calculations.

About the process:

"*Data is gathered in web based data templates and the quantification system is automated so that the people within an organisation do not need to spend enormous amounts of time inputting the data. The smart solution is able to access information from multiple source in a transparent, easily verifiable, reproducible and scientifically defensible manner.*" **- Markus Tykkyläinen, E.ON Kainuu**

10. Validity, integrity, privacy of the data

All the measurements which are the ground for the invoicing must fill the requirements of the EU directive 2004/22/EY. This is a solid ground for the energy related main measurements. But when talking about the measurements and need for measurements, it is important to recognize that not all the need for the measurements is related to invoicing, and therefore the accuracy of the measurement not always needs to be as good as in the official invoicing. This issue is relevant when talking about the communicative purposes in the measurement data usage. When building up for example a visual presentation of the energy usage of a building or some sub processes of for example a hotel, the more detailed measurements are not used for invoicing but to understand better the energy consumption in a process or product level. And when understanding that the requirement for the accuracy of a measurement is no longer very tight, it allows using lighter and simpler measurement equipments. This is an important issue to discuss always when planning more detailed measurements for the energy usage. This issue becomes even more obvious when using the data in for example CO_2 calculations, where the methodology and other raw data uncertainties exceed the uncertainty of the lighter sub measurement accuracy.

The hourly consumption data is interpreted as sensitive data from a consumer point of view. It gives detailed information about the consumer living habits and may even cause theoretically a security risk when showing when the building is not in use. There are several reasons for handling the measurement data as confidential. There is discussion going on in the energy branch who is the owner of the data. The perspective to this issue may change within let us say the next five years. At present the data is gathered and stored in the energy company data bases, and only with a permission from the customer, the measurement data can be delivered to a third party. Managing the privacy and mandate issues is one challenge to be solved also in the environmental information market place.

11. Key factors and the outcomes of the study

Carbon footprint of a guest night amounts to around 16 kgCO2e per night. In line with other carbon footprint studies biggest impact is from utilities (electricity, heat and water). Utilities represent almost 60 % of total footprint. Impact from waste is particularly high, per guest night which may result from data validity. Closer study of actual waste amounts should be done to adjust the size waste footprint.

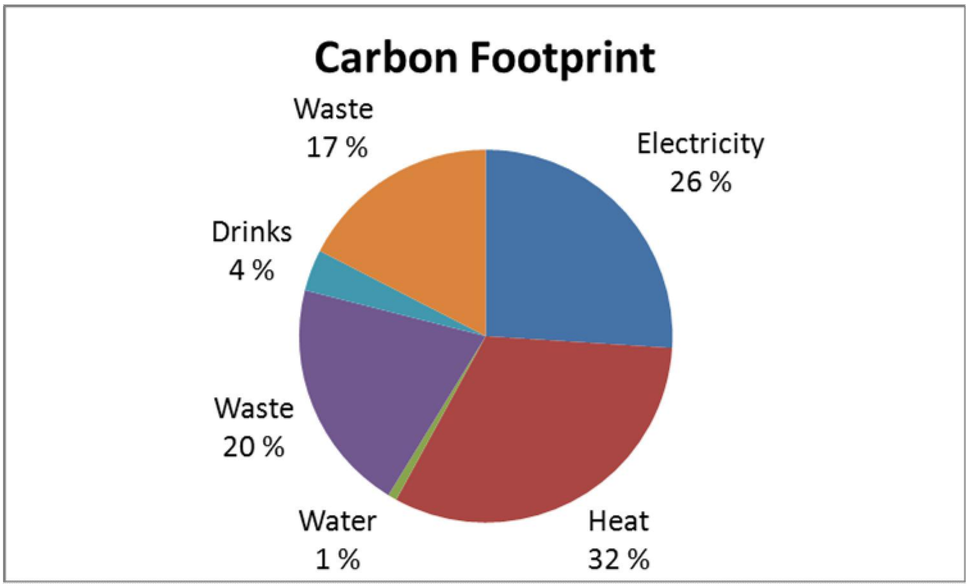
Previous study by Natural Interest showed that on average Swan labeled hotel averages around 22 kgCO2e per guest night. S-hotel have a lower footprint. However S-hotel did not measure their use of chemicals, which in the previous study amounted to around 15 % of total footprint. Carbon footprints therefore are not directly comparable.

This information should be used to target to reduce emission big hitters, mainly electricity and heat.

Table 4. Results of carbon footprint calculations per guest night in kg CO_{2e}

Per guest night	kg CO_{2e}
Electricity	4,09
Heat	5,02
Water	0,12
Water	3,18
Drinks	0,56
Food	2,74
Total	**15,71**

Diagram 1. Carbon footprint composition by category



In this case the challenges have been:

First, to define the most streamline way to handle the measurement data from the meters to the operator, who uses the data as a raw material for further studies or makes it into such a format which is easy to be communicated. In this question there are parallel possibilities for data handling; the hotel has got a modern building automation system with many unutilized features for reporting, and at the same time, the electricity distribution company has already got a remote reading system for the electricity measurements. The question in a technical sense is that should the building automation system be developed to be the reporting and data gathering tool, or should the remote reading system be utilized by adding into the channel more measurement data beside the electricity energy. In this case the outcome has been that the building automation system has been developed further, and also the electricity distribution company remote reading system is expanded to the district heating energy measurement delivery. It should not be seen as putting effort in vain, but rather building a ground for development which is not yet fully clear, but will be seen in the future. In a hotel building there are several different products and services which the customer uses. When building a channel for the measurement data to be delivered to the energy company, the same channel can be used to deliver also the data from sub measurements, giving more detailed information about the internal processes. The requirements for the sub measurements do not have to be as tight as for the official invoicing measurements, and therefore the expenses for the equipments are not so high. This sub measurement was not implemented yet in this case, but it was seen a tool to allocate the CO_2 emissions to a more detailed level.

Second, when making the decision about the data gathering and delivering technology, it obviously means also fitting together different actors owned equipments and technology. This needs a common understanding and good communication between the actors. In this case this communicative perspective did not come as an issue, because all the actors around this issue (building automation system provider,
building owner, district heating operator, electricity distribution company) had a positive attitude towards testing something new.

Third, formulizing the data to a useful format. The previous questions concern the technical issues to build up a ground for data providing. In the Sokos Hotelli Vuokatti case, as in other cases also, the important question is; who is interested in the energy consumption data? Is the data itself interesting, or should it be seen as a raw material for calculating something interesting? When the data is gathered to one data base, the delivery for the one who wants to see or use the data, has to be solved. The electricity distribution company E.ON Kainuu Sähköverkko Oy has developed technology to communicate the data to the customers via web-portal. In this case study it for the first time was expanded to handle not only the electricity distribution data, but also the district heating data (water temperatures, energies). The web portal gives an opportunity for the customer to monitor the energy consumption (in this case; all supplied energy). It also includes a possibility to take the data out of the portal to a excel-sheet, which gives good opportunities for further analyses.

The idea from the data handling perspective in this Envitori case is to build up a cloud structure for the data, and giving possibilities for different actors to use the data, and to build up or make better different services or products. Previously is described how the data gathering is done for Sokos Hotelli Vuokatti. There is still a gap between this solution and the cloud thinking.

Some constrains has to be taken into account: the energy measurement data is considered as confidential data, and there are restrictions to whom it is allowed to be delivered. This makes one issue which has to be taken into account. When the electricity distribution company gives forward data from some customers energy usage, there needs to be a clear permission from the customer, and it should be known for what the data is used. From the electricity distributor perspective the authorization procedure is a MUST issue for developing the cloud thinking. Additionally, when talking about processes which are not directly connected to the distribution company's core business (regulated by the authorities), the procedures must be easy and trustful from the electricity distributor perspective. Any complicated, expensive or unsecured ways of data delivering and authorization build up a barrier for delivering the data.

In many business cases the most critical question is that what is the customer need which needs to be full filled, and even further; if there is no recognized need YET among the customers, what need should be created?

The EU regulation with all the ambiguous targets in increased energy efficiency and letting the customer choices to lead towards the more renewable energy production and more efficient energy consumption, really relies on the idea that transparency generates positive choices from the environmental perspective. There is no reason to doubt this. And even though one doubts this idea, if the regulation develops towards increased transparency, actors must develop their processes towards it. This is valid for the energy companies what comes to the energy consumption data, energy sources used for producing the electricity, the emissions caused by the production of the consumed energy. So, despite the trust on the affect of transparency, it is a strong trend in the regulation dealing with environment and energy sector. Making the energy consumption visible by providing web portals and information to the customer is acting in line with the strong political intentions. But the customers for the energy sector, in this case a hotel, is facing the same questions in relation with the consumer and company customers. For example companies using the hotel services in their own environmental performance report, want and will more and more, covering larger and larger part of their operation, report the environmental effect. Staying night in a hotel is for a company and for an individual consumer also a choice which causes some kind of environmental foot print. The belief behind this Envitori WP3 case is that one should take steps to be able to report in an understandable way the economical foot print of different services and products, also what does it mean from the ecological perspective to make a choice to stay a night in Vuokatti, and specially in Sokos Hotelli Vuokatti.

12. Study findings by case partners

This chapter discovers the study findings by case partners; E.ON Kainuu, Natural Interest and Elisa Oyj.

12.1. Finding by E.ON Kainuu

For E.ON this study has given the following findings this far; There is not monitored a clear and concrete “need” among the customers for the environmental data, not at least such a need which could be utilized immediately by providing a solution, and seeing a clear positive economical benefit in the customers (= company) cash flow.

Nevertheless in the discussions with several actors in this study, the trend seems to be strong still, and even though the target is not quite clear, the intuition among the actors that “this is a good thing” is a driver which pushes the development further and encourages for further re-sourcing to this.

Sometimes the customer need needs to be awaken, and this may be the case in this WP3 case also. By building up a pilot project with attractive outcome, transparency in the operation CO2 foot print and visions of increased process efficiency and better environmental imago, it eventually could awaken the customer need in the Vuokatti area, and further

12.2. Findings by Natural Interest

From previous experience it was clear carbon footprinting a hotel would not provide much of a challenge. Using well structured secondary data database allows high quality carbon footprinting provided primary data is in the right form. Therein lies the problem Data collection has been recognized as a bottle neck for carbon footprinting development. We are still experiencing teething problems in the field and this study went on to strengthen that argument. Lack of resources in data gathering and understanding of usefulness of carbon footprints is the biggest obstacle in utilizing the data in best possible ways.

For Natural Interest this study gave better understanding of the challenges of automated data gathering. Automated data gathering solution can be built, problem is that primary activity data is not necessarily located in a system or in the form that allows carbon footprint calculations. Data is not necessarily metered, it required allocation of the data is required or is too general.

Therefore primary data needs tweaking which may require a lot of manual work in data collection, thus limiting the possibilities for automated data utilization.

Due to problems finding a case partner concept was only tested in a hotel environment. Other companies with more sophisticated ERP-systems may handle consumption data in a more suitable form for automated data gathering.

12.3. Findings by Elisa

As the primary goal for the Elisa was to research the technical architecture of the marketplace of the environmental information, this study was started too hasty. Meaning that there were too many open parameters unknown to build up and design the proper system from the beginning.

As some of the key things before planning a technical solution, are solve the questions; what is the customer need or the wanted business case to solved, what kind an information is handled and what are the known application protocol interfaces. This study case gave some of these answers when the study was almost over. Therefore there are still many open key questions to be solved. For example; what kind data the market place community are willingness to share and what is the information the community want to see in the marketplace.

During this study, Elisa was researching and developing a new kind evolutionary event based SIMA-architecture (Session Initiation Protocol Instant Messaging Architecture) in the background. The first plan was to use this early state prototype as in core of the marketplace. How ever as mentioned in earlier in this document, it was too hopefully thinking because of the lag of time and resources (working hands and money). Therefore Elisa focused more in this study to the project management and handovered most of the technical ideas and solutions to WP1, which should out print all the discovered findings at there.

13. Further Research

It is not yet clear to companies how to make best use of CO_2 data in their business environment, as was the case for S-hotels. Although this study was fully focused on data gathering and carbon footprinting, results should be analyzed further and tested where CO_2 data can give real business benefits either in resource or carbon management, PR, carbon market analysis etc. This study gave ‘nice to know’ information for S-hotels but more structured approach in data utilization is required in the future.

In addition to calculating carbon emissions, it is recommended that S-hotels seeks guidance on the progression of its carbon management plan. A clear carbon management strategy should be underpinned by clear plans and actions being integrated into existing processes. Performance and progress should be monitored and communicated internally. Once plans are under way and progress is demonstrable, a range of communication and marketing initiatives should be developed to reap the benefit of a proactive stance on carbon management.

There is need to process further the theoretical framework of the environmental data market place. The value chains should be analyzed in more detailed level, for example by starting with a pilot process or product. The hotel environment in Sokos Hotel Vuokatti still includes potential for further analyses. The CO_2 footprint calculation in more detailed level is an attractive option, and should be developed further. There is a lot of communicative work to be done to get a critical mass of local actors involved with the market place, and it can be only done by building up an attractive concept with simple and concrete benefits for the enterprises.

Annex A

Table A.1 Direct (except for CH_4) global warming potentials (GWP) relative to CO_2

Industrial designation or common name	Chemical formula	GWP for 100-year time horizon (at date of publication)
Carbon dioxide	CO_2	1
Methane[c]	CH_4	25
Nitrous oxide	N_2O	298
Substances controlled by the Montreal Protocol		
CFC-11	CCl_3F	4,750
CFC-12	CCl_2F2	10,900
CFC-13	$CClF_3$	14,400
CFC-113	CCl_2FCClF_2	6,130
CFC-114	$CClF_2CClF_2$	10,000
CFC-115	$CClF_2CF_3$	7,370
Halon-1301	$CBrF_3$	7,140
Halon-1211	$CBrClF_2$	1,890
Halon-2402	$CBrF_2CBrF_2$	1,640
Carbon tetrachloride	CCl_4	1,400
Methyl bromide	CH_3Br	5
Methyl chloroform	CH_3CCl_3	146
HCFC-22	$CHClF_2$	1,810
HCFC-123	$CHCl_2CF_3$	77
HCFC-124	$CHClFCF_3$	609
HCFC-141b	CH_3CCl_2F	725
HCFC-142b	CH_3CClF_2	2,310
HCFC-225ca	$CHCl_2CF_2CF_3$	122
HCFC-225cb	$CHClFCF_2CClF_2$	595

Industrial designation or common name	Chemical formula	GWP for 100-year time horizon (at date of publication)
Hydrofluorocarbons		
HFC-23	CHF_3	14,800
HFC-32	CH_2F_2	675
HFC-125	CHF_2CF_3	3,500
HFC-134a	CH_2FCF_3	1,430
HFC-143a	CH_3CF_3	4,470
HFC-152a	CH_3CHF_2	124
HFC-227ea	CF_3CHFCF_3	3,220
HFC-236fa	$CF_3CH_2CF_3$	9,810
HFC-245fa	$CHF_2CH_2CF_3$	1,030
HFC-365mfc	$CH_3CF_2CH_2CF_3$	794
HFC-43-10mee	$CF_3CHFCHFCF_2CF_3$	1,640
Perfluorinated compounds		
Sulfur hexafluoride	SF_6	22,800
Nitrogen trifluoride	NF_3	17,200
PFC-14	CF_4	7,390
PFC-116	C_2F_6	12,200
PFC-218	C_3F_8	8,830
PFC-318	$c\text{-}C_4F_8$	10,300
PFC-3-1-10	C_4F_{10}	8,860
PFC-4-1-12	C_5F_{12}	9,160
PFC-5-1-14	C_6F_{14}	9,300
PFC-9-1-18	$C_{10}F_{18}$	>7,500
Trifluoromethyl sulfur pentafluoride	SF_5CF_3	17,700
Fluorinated ethers		
HFE-125	CHF_2OCF_3	14,900
HFE-134	CHF_2OCHF_2	6,320
HFE-143a	CH_3OCF_3	756
HCFE-235da2	$CHF_2OCHClCF_3$	350
HFE-245cb2	$CH_3OCF_2CHF_2$	708
HFE-245fa2	$CHF_2OCH_2CF_3$	659
HFE-254cb2	$CH_3OCF_2CHF_2$	359
HFE-347mcc3	$CH_3OCF_2CF_2CF_3$	575
HFE-347pcf2	$CHF_2CF_2OCH_2CF_3$	580
HFE-356pcc3	$CH_3OCF_2CF_2CHF_2$	110

Industrial designation or common name	Chemical formula	GWP for 100-year time horizon (at date of publication)
HFE-449sl (HFE-7100)	$C_4F_9OCH_3$	297
HFE-569sf2 (HFE-7200)	$C_4F_9OC_2H_5$	59
HFE-43-10-pccc124 (H-Galden 1040x)	$CHF_2OCF_2OC_2F_4OCHF_2$	1,870
HFE-236ca12 (HG-10)	$CH_2OCF_2OCHF_2$	2,800
HFE-338pcc13 (HG-01)	$CHF_2OCF_2CF_2OCHF_2$	1,500
Perfluoropolyethers		
PFPMIE	$CF_3OCF(CF_3)CF_2OCF_2OCF_3$	10,300
Hydrocarbons and other compounds – direct effects		
Dimethylether	CH_3OCH_3	1
Methylene chloride	CH_2Cl_2	8.7
Methyl chloride	CH_3Cl	13